Internationally comparative dataset on start-up processes and their institutional foundations in Germany, Italy, the UK and the US

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1. Executive summary

We here describe the empirical approach taken to collect the “perfect timing (PT) database”, which traces the timing of labour-, finance-, and knowhow-related activities throughout the venture creation process on a monthly basis. The sample for this study was drawn from the Orbis database, which provides internationally comparable company profiles. A rigorous catalogue of selection criteria was developed and applied to arrive at a meaningful sample. To collect data in Germany, the US, the UK, and Italy, national call centers were contracted after a thorough tender process. While these call centers recruited venture founders for an interview, the actual interviews were conducted by an interviewer team of research assistants, based at Utrecht University (the Netherlands), Columbia University (NY, USA), the Universität zu Köln (Germany), and the Heinrich-Heine Universität Düsseldorf (Germany). These interviewers were selected and rigorously trained by the survey coordinators. These data collection efforts enabled the recruitment of 820 interviews and completion of 539 interviews within the FIRES project. Together with the already existing data of the preceding Marie Curie project, the PT dataset includes 1044 cases.

2. Internationally comparative dataset on start-up processes and their institutional foundations in Germany, Italy, the UK and the US

1. Introduction

The seminal paper by Gartner (1988) led to a paradigm shift in entrepreneurship research. In line with his paper's title, Gartner argued that asking "(w)ho is an entrepreneur (…) is the wrong question" as entrepreneurship research ought to be process- rather than trait-oriented. While the trait-oriented studies of the 1970s and 1980s succeeded in identifying the core characteristics of entrepreneurs, they did not provide insights into the process to be undertaken when setting up a new venture. Such insights are, however, essential in order to learn about the steps needed for venture creation.

Gartner's claim was taken-up by many, thereby initiating the process-oriented school of entrepreneurship research. The need for data on venture creation processes led to the collection of several datasets, of which the Panel Study of Entrepreneurial Dynamics (PSED) is to date the most comprehensive one (Reynolds and Curtin 2007). Around the turn of the millennium, the PSED contributors interviewed - in two waves - ca. 1000 founders of nascent ventures about the steps undertaken during the venture creation process (Reynolds and Curtin 2008). While the PSED study was replicated, often in modified versions, in Argentina, Australia, Canada, Greece, The Netherlands, Norway, Sweden, and the UK, (idem: 167-168), the PSED focuses on identifying reference dates of many activities, such as the moment of corporate inclusion in the yellow pages. Start and end dates of particularly important venture creation activities, e.g. of R&D collaborations, are often missing. Precise time-stamped data is however needed in order to understand how the duration of activities, their timing within the overall venture creation process, as well as their completion in relation to other start-up activities shapes the venture creation process and its outcome.

To uncover patterns of venture creation processes, as well as their (institutional) drivers, the 'Perfect Timing' (PT) dataset was collected between 2011 and 2018. Led by Andrea M. Herrmann, research teams at Utrecht University (the Netherlands), Columbia University (NY, USA), the Universität zu Köln (Germany), and the Heinrich-Heine-Universität Düsseldorf (Germany) collected information on overall 1044 venture creation processes in collaboration with Saul Estrin (London School of Economics) and Luca Grilli (Politecnico di Milano).[1]

[1] Between 2011 and 2013, these data collection efforts received funding from a Marie Curie International Outgoing Fellowship within the 7th European Community Framework Programme, from the QMSS program at Columbia University (New York, USA), and from the Innovation Studies Group at Utrecht University (The Netherlands). Between 2015 and 2018, data collection was funded by the European Union's Horizon 2020 research and innovation programme under grant agreement No 649378.

These data collection efforts translated into an internationally comparative dataset on start-up processes of alternative energy, as well as information & communication technology ventures, in Germany, Italy, the UK, and the USA.[2] For these countries, the PT database provides monthly information on the activities undertaken to build-up human resources, acquire finance, and develop the core business idea of the new venture. While the PT dataset contains more time-stamped information than PSED, it explicitly includes variables that enable merging PT and PSED data. The PT data thus constitutes an important resource for advancing scholarly understanding of venture creation processes.

The following summarizes the empirical approach taken to collect the PT database. To this end, it illustrates the sampling approach taken, project administration, and the rationale underlying the questionnaire. It furthermore discusses the interview schedule, data cleaning, and data reliability.

2. Conceptualization and Data Collection Activities

2.1. Sampling Approach and Sample Characteristics

The question of how to arrive at a meaningful sample is intimately linked to the question of how to conceptualise entrepreneurship. As (Reynolds and Curtin 2007: 3) note, the literature uses a variety of concepts and indicators, including "self-employment as a proxy for entrepreneurship, (…) new market entrants, (…) new listings in registries of business organizations, (…) the emergence of new industries or types of organizations (…), retrospective histories [of particularly successful ventures], and a wide range of samples of convenience.".

Combining different aspects of these conceptual and empirical approaches, we define entrepreneurship in this study as *economic activity by one or more individuals that translates into the registration of a new, independent for-profit firm*. Importantly, this definition excludes self-employed individuals that are not incorporated, as well as firms that are registered as a subsidiary or otherwise financially dependent entity of a larger company.

Based on this concept, we used a venture's ***registration year***, ***legal form***, ***country***, and ***industry*** as sampling criteria. To obtain an internationally comparative sample, we used the ORBIS database of Bureau van Dijk, which offers ample corporate information including the ***registration date of firms*** at a chamber of industry and commerce or a comparable authority (see https://www.bvdinfo.com/en-gb/our-products/data/international/orbis). Given that data collection started in 2011 and ended in 2018, we decided to include all years of corporate

[2] In addition, the dataset contains information on about 50 venture creation processes in the Netherlands. For the Netherlands, data coverage is thus more limited and less systematic.

registration between 2004 and 2014.[3] These registration dates leave sufficient time to trace venture development after registration. Most importantly, this sampling approach has the advantage of including ventures that became successful after registration by making sustainable profits, as well as ventures that failed and were thus dissolved. Furthermore, these registration dates offer the advantage of being sufficiently close to the interview date, so that founders still remembered the venture creation activities undertaken. This is particularly important as numerous venture creation activities already took place before the venture's registration at a chamber of industry and commerce or a comparable authority.[4]

We used the ***legal form*** under which a venture was registered to exclude public corporations, not-for-profit organisations, foundations, associations, cooperatives, as well as liberal professions and solo self-employed.

Akin to the Global Entrepreneurship Monitor (GEM), also the PT study considers the ***country*** as an essential unit of analysis (see Reynolds, Bosma et al. 2005: 208), because differences in institutional influences on venture creation processes are likely to be particularly pronounced between national institutions (Hall and Soskice 2001). Accordingly, the FIRES project in general, and the PT survey in particular, decided to study venture creation processes in three European countries with particularly distinct and representative institutions of Continental European, Anglo-Saxon and Mediterranean economics: namely Germany, the UK, and Italy (see Hall and Soskice 2001; Amable 2003; Hancké, Rhodes et al. 2007; Schneider and Paunescu 2012). In addition to these countries, the PT study also covered the US as the latter is said to offer the most favourable institutional environment for entrepreneurship.

In addition to these four countries, the PT sample also focuses on specific sectors and ***industries***, namely the alternative energy sector (including solar, wind, and biomass industries), as well as the information and communication (ICT) sector (including information and communication industries alike). While both are forward-looking, the alternative energy sector has been massively subsidized over the past decades, while the ICT sector has not received any sector-specific subsidies. The impact of subsidies on venture creation processes thus becomes particularly well visible in alternative energy ventures.

Both NACE (Rev.2) and ISIC (Rev.4) classifications include a specific industry code for ventures pursuing telecommunications and computer-related activities, so that ICT ventures were directly identifiable. Importantly, though, there are no separate industry codes for alternative energy ventures. Accordingly, alternative energy ventures are included in broader sectoral classifications, such as 'electric power generation, transmission and distribution' – to name just one of the seven, eight, and respectively nine industry codes we used for locating wind, biomass, and solar firms within the broader sample. In a next step, we then used the venture's trade description to manually single out the wind, biomass, and solar

[3] Ventures that were registered in 2006-2012 were approached first with the request for an interview, ventures registered in 2004, 2005, 2013, and 2014 were approached once the 2006-2012 samples were exhausted.

[4] For illustrations about data reliability, see section 2.6 below.

ventures from this broader sample.[5] Whenever in doubt, the venture's core activity was cross-checked via a www-search.

Given that 'Computer Assisted Telephone Interviews' (CATI) interviews could only be conducted with founders of ventures with a telephone number, the availability of a phone number *de facto* became an additional sampling criterion.

2.2. Project Administration

To secure data quality, reliability, and completeness, the data collection process was split in three parts: First, for each country surveyed, a call center was commissioned to identify and recruit interview partners (mostly founders) who were sufficiently knowledgeable about the start-up process of the ventures sampled. After a thorough tender process, that call center was selected which only worked with native speakers and was sufficiently experienced in founder surveys in the respective country. After a thorough training process, the callers contacted ventures and identified suitable interview partners to participate in the PT survey. In doing so, the callers cross-checked the aforementioned sampling criteria (most importantly, the venture's industry and independence from a mother company).

In a second step, the actual interviews with founders were completed. To this end, research assistants were recruited after a thorough selection process. All research assistants were students (or former students) of different business-, management- or innovation-related study programs at Utrecht University (the Netherlands), Columbia University (NY, USA), the Universität zu Köln (Germany), and the Heinrich-Heine-Universität Düsseldorf (Germany). Next to their overall performance, motivation and time commitment to the project, the interviewers' language skills were a major selection criterion as only native speakers or interviewers with equivalent language skills were hired. In preparation of their first interview, these research assistants were thoroughly trained by the project leader (A.M.Herrmann) and her assistants (most importantly Lukas Held), by listening to audio recordings of previous interviews, and by completing trial interviews amongst each other. Once trained, the research assistants recorded their interviews with founders (whenever permission was granted).

In a third step, the data collected was cross-checked by the survey coordinator: Upon completion of the interview, the research assistants forwarded the interview recordings to the survey coordinator (most importantly, B.Fischer and A.M.Herrmann). The survey coordinator either listened into these recordings or clicked through the online CATI questionnaire in order to clean the data in the questionnaire, and to provide feedback to the interviewers (for details, see below section 2.5 "Data Cleaning"). This constant feedback process did not only assure high data quality, completeness, and reliability; it also constituted an ongoing training process for the interviewers.

[5] For US ventures, trade descriptions were not available. We thus took the venture name (for example, for solar ventures, "sol*", "lux", "green", "energy", "photo", "vol", "helio" – and many more) to identify the venture's industrial activity.

While the aforementioned process of project administration remained the same throughout the entire period of data collection (from 2011 – 2018), it should be noted that data collection took place in two waves: From 2011 – 2014, data collection of the PT database was initiated by A.M.Herrmann within the framework of a Marie Curie fellowship at Columbia University (New York). The questionnaire was developed on the basis of thorough literature studies, in-depth interviews with entrepreneurs and in close collaboration with experts and practitioners in the field. It was tested through interviews with founders of applicable ventures and repeatedly modified until a concise questionnaire had been developed. During the first wave, data collection focused on Germany, the USA, and the Netherlands. Consequently, native-speaking interviewers were not only recruited and based at Utrecht University (the Netherlands), but also at Columbia University (USA), as well as the Universität zu Köln (Germany) and the Heinrich-Heine-Universität Düsseldorf (Germany). These data collection efforts were financed by a Marie Curie International Outgoing Fellowship within the 7th European Community Framework Programme, by the QMSS program at Columbia University (New York, USA), and by the Innovation Studies Group at Utrecht University (The Netherlands).

In view of the scholarly interest that the PT database had triggered already in 2014, the H2020 FIRES consortium decided to finance additional data collection efforts. A second wave of data collection thus took place between 2015 and 2018, which aimed at broadening the existing US and German datasets, and at collecting new data for the UK and Italy. During this second wave, the questionnaire of the first interview wave was broadened by including questions that enable merging the PT and PSED datasets. Furthermore, questions about the socio-economic characteristics of founders, about investment amounts, writing a business plan and patenting activities were added. These questions were added after thorough literature studies and in consultation with various FIRES colleagues, most notably Saul Estrin (London School of Economics), Luca Grilli (Politecnico di Milano), as well as Niels Bosma and Mark Sanders (Utrecht University). In addition to conducting new interviews in Germany, Italy, the UK and the USA, the existing German and US interviews of the first wave were completed by re-calling the interview partners of that time. These follow-up interviews also offered a valuable opportunity to cross-check the data reliability of the PT study (see section 2.6).

2.3. Questionnaire Design

To ensure that dozens of interviewers in different countries could assist in data collection, a structured interview guide was developed for a survey based on ‘Computer Assisted Telephone Interviews’ (CATI). This interview guide made it possible to systematically capture venture creation circumstances and to trace how venture creation processes evolved on a monthly basis. To this end, the questionnaire contains six parts.

Part I of the questionnaire records the venture details and circumstances of venture creation, such as the venture’s *industry*, *location*, *year of registration*, l*egal form*, *business idea (product or service)*, *novelty*, *degree of innovativeness*, and *location of core customers*.

Part II captures the length of the venture creation process by identifying its start and end date. In line with the process-oriented entrepreneurship literature (Reynolds and Curtin 2008), the PT uses different ways to determine when venture creation started and ended respectively. These indicators can be used alternatively. Possible start dates include:

- the moment when the *interview partner* first *thought* about setting-up the venture in question,
- the moment when *one of the founders* first *talked* about setting-up the venture in question,
- the moment of *corporate registration* at a chamber of commerce or a comparable register,
- if applicable, the moment when one of the founders started *writing a business plan*.

Possible dates to determine the end of venture creation include the respective moments

- when the new venture first generated *revenues*, *profits*, or respectively *sustainable profits* for more than 3 months, as well as the moments
- when the venture *merged*, was *acquired*, or *dissolved*.

Parts III, IV, and V inquire into the timing of activities that took place during venture creation. Contrary to PSED, the PT survey does not seek to cover a broad variety of activities (such as the moment of inclusion in the yellow pages or of opening a bank account) but rather captures detailed time-stamped information on those activities that can be considered essential for (the success of) any venture creation process. Economic theory, the resource dependence view (Pfeffer and Salancik 1978), and the varieties of capitalism literature (Hall and Soskice 2001) – to name just some particularly influential literature strands– teach us that a company cannot operate without labour (or human capital), finance (or financial capital), and know-how (needed for product development). Accordingly, part III asks about how the venture's labour composition evolved over time; part IV enquires into finance acquisition; and part V captures how the necessary know-how for product/service development was acquired.

More precisely, part III traces – on a monthly basis – how many *founders*, *employees*, and *service providers* worked for the venture on a part-time or full-time basis respectively. Furthermore, the socio-economic background of the founders is retrieved, namely their marital status, financially dependent children, highest degree obtained, prior occupation and venture creation experience, as well as their motives for setting up the new venture.

Part IV inquires into the different financial sources that the venture acquired, including:

- *shareholder capital* by founders, their family and friends, as well as corporate investors including venture capital firms and business angels.
- *loans* provided by banks and other corporate investors, as well as by different types of private investors.
- *subsidies, grants and other funding that the venture did not need to pay back.*

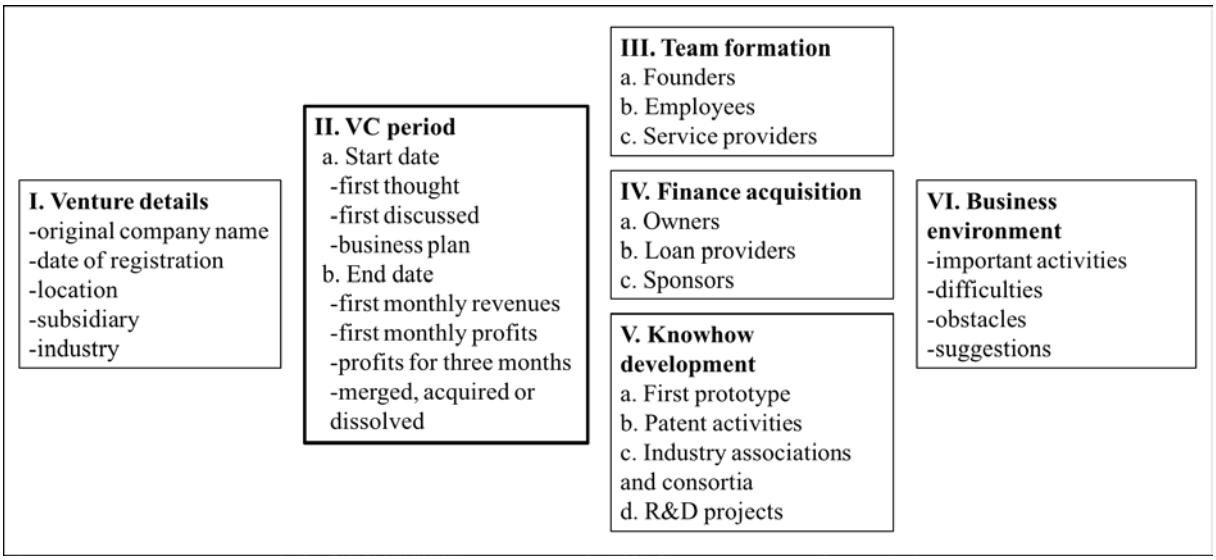
For any of these financial means, part IV asks about the beginning and end dates of funding acquisition, as well as the amount of finance that was invested.

Part V traces the process of product development, that is, the development of the first prototype of the venture's core business idea. In addition to the timing of prototype development, part V captures whether the venture developed its core business idea on its own, in collaboration with academic or corporate R&D partners, or within the framework of a larger consortium or industry association. Furthermore, if applicable, the timing of patenting activities is recorded.

Importantly, the questionnaire also seeks to identify possible institutional influences on venture creation. Given that founders within one institutional context (i.e. country or region) typically take the latter for granted as they, simply, do not have a cross-institutional comparison, differences in national or regional institutions cannot be established by asking directly about them. Instead, they rather become visible indirectly through systematic differences in economic behaviour or judgements about the venture creation context. To capture such differences, the questionnaire also includes several open questions asking about whether and, if so why, founders were reluctant to give up dependent employment or to hire employees. Furthermore, the questionnaire asks about possible difficulties experienced in obtaining institutional investment and about the types of support obtained from institutional investors. Finally, part VI asks about those activities that founders experienced as particularly important and, respectively, difficult when setting-up their ventures. Furthermore, it enquires into whether founders experienced any regulatory obstacles during venture creation and asks what policy-makers could do to facilitate venture creation.

Figure 1 provides an overview of the six parts covered during in the PT survey as well as the major questions covered within each part.

Figure 1: Structure of PT Timing Interview Schedule



2.4. Interview Schedule

The master version of the CATI questionnaire was developed in English and then translated into all applicable languages, i.e. German and Italian. These translations were thoroughly cross-checked and reviewed by native speakers. For each language, at least three native speakers participated in the review. Their inputs were consolidated and implemented by the survey coordinator before data collection began.

The duration of each interview varied depending on the complexity of the venture creation process. On average, an interview lasted about 40 minutes. Interviews were conducted typically with the venture founder or, in about 5% of the cases, with another person who was particularly knowledgeable about the venture creation process, namely a family member (wife, sibling of the founder), employee, or core investor. Following the CATI procedure, the interviewer read the questions to the respondent as they appeared on the computer monitor and then entered the answers directly into the online survey. To ensure data **consistency**, the computer program automatically led the interviewer to the relevant follow-up questions.

Each interview started with the interviewer informing the respondent about his/her rights, stipulating the voluntary nature of the interview, the right not to answer, to stay anonymous, raise questions, interrupt - or withdraw from - the interview, as well as the required minimum age of 18 years to participate. The respondents were asked to provide their formal consent to these conditions and were given the opportunity to indicate whether, or not, they would allow for the interview to be recorded. In more than 95% of the cases, this permission was granted.

Once the interview partner was informed about his/her rights, the interviewer proceeded to the actual questionnaire. As mentioned in section 2.3, the main questionnaire contains six central parts recording: (I) venture details, (II) the venture creation period, (III) the team formation process, (IV) finance acquisition, (V) knowhow development and (VI) the founder's opinion about the business environment (see figure 1 for an overview of the interview schedule and its central elements).

During interviews, the most critical point of part I was to determine whether the recruited start-up conformed to the sampling criteria: Interviews were conducted only with founder of those ventures that were (a) founded as the original company and were no successor organization, (b) registered in either Germany, the UK, the USA or Italy, (c) were no subsidiary and (d) active either in the ICT or alternative energy sector. If these criteria were not fulfilled, the interviewer abandoned the interview. Furthermore, essential information about the venture's core business idea (product/service) was collected, such as its degree of novelty and envisioned customer spectrum.

Part I was followed by one central element of the questionnaire: the identification of the time span of venture creation (part II). For the CATI procedure, the start date of a venture creation process was defined as the moment (indicated by the interviewee) when one of the founders first discussed the idea with another person to set up the business in question. The

end date was determined as the moment when the venture made profits for three consecutive months, or when it was merged, acquired or dissolved. For those cases where a venture was neither profitable for three consecutive months nor merged, acquired or dissolved, venture creation was considered to be ongoing until the day of the interview.

The time span of venture creation identified in part II served as a reference period for all following sections of the interview schedule. In part III, the respondents were asked to indicate the involvement periods of the venture's founders, employees and service providers specifically during the identified venture creation time frame. Similarly, in part IV, the interviewer enquired into the investment periods of owners, loan providers and sponsors. Likewise, part V asked about the development process of the venture's core business idea (product/service), its patenting activities, R&D projects and participation in industry associations and consortia throughout the venture creation process. The restriction of data collection to a specific timeframe enabled the interviewers to focus on those events that were most relevant during the early start-up phase.

To investigate the influence of a venture's institutional environment on venture creation, the interview schedule was designed specifically to combine systemic quantitative data with relevant qualitative insights. While most of the questions thus produce fine-grained quantitative data about the timing and sequences of venture creation activities, the interview schedule also incorporates qualitative, open questions. Most notably, section VI poses four open questions to gain a more profound understanding of the business environment in which the new venture was set up.

All items included in the questionnaire have been carefully crafted and tested to provide a comprehensive picture of the events that occur during venture creation. To facilitate the interview procedure, the underlying rationale and focus of each question were thoroughly explained to the interviewers. This approach did not only create the necessary interviewer confidence to guide the respondents, it also was at the basis of collecting meaningful data. Overall, a total of 886 interviewees report complete data on all items of the questionnaire. An additional 158 interviews provide useful data on at least parts of the questionnaire, so that the entire dataset contains overall 1044 cases. Table 1 provides an overview, including separate information (by country and industry) of the interviews recruited and conducted during the first (Marie Curie) and the second (H2020) data collection wave.

Table 2: Interviews Recruited and Completed (by Country and Industry)

Overview by Country and Industry	Data Collection Marie Curie		FIRES Interviews Envisaged		FIRES Recruited	Data Collection FIRES		PT Dataset Overall (Marie Curie + FIRES)	
	All interviews conducted	Complete interviews conducted	Additional interviews envisaged	Overall number of interviews envisaged	Number of interviews recruited	All interviews conducted	Complete interviews conducted	Overall number of interviews available	Overall number of complete interviews available
Germany	**265**	**213**	**100**	**300**	**168**	**113**	**100**	**378**	**313**
- of which IT	169	137			n.a.	49	45	218	182
- of which AE	91	71			n.a.	62	55	153	126
USA	**187**	**163**	**100**	**300**	**172**	**101**	**72**	**288**	**235**
- of which IT	135	117			n.a.	54	41	189	158
- of which AE	48	40			61	45	31	93	71
UK	**0**	**0**	**300**	**300**	**301**	**181**	**158**	**181**	**158**
- of which IT					250	142	126	142	126
- of which AE					51	39	32	39	32
Italy	**0**	**0**	**300**	**300**	**179**	**144**	**133**	**144**	**133**
- of which IT					112	98	90	98	90
- of which AE					67	44	43	44	43
NL	**53**	**47**	**0**	**0**	**0**	**0**	**0**	**53**	**47**
- of which IT	26	21				0	0	26	21
- of which AE	27	26				0	0	27	26
Σ	**505**		**800**	**1200**	**820**	**539**	**463**	**1044**	**886**

2.5. Data Cleaning

A comprehensive cleaning procedure was established to ensure that all data gathered is consistent. Each interview conducted was individually reviewed for quality and consistency by at least one survey coordinator, who carefully listened to the interview and, if necessary, cleaned the data in the CATI questionnaire in line with the responses of the interviewee. In particular, the survey coordinator cross-checked the chronology of events, the industry and product of the new venture, its degree of innovativeness, whether breaks between time periods were meaningful, whether all notes taken were understandable to outsiders, and whether all mentioned dates for team formation, investments and knowhow development were within the time frame of the venture creation process. To do this, the survey coordinators relied not only on the information provided by the respondent, but also on venture information that was available online.

Minor inconsistencies could be corrected directly by the survey coordinator. Such minor inconsistencies generally referred to situations in which a response was not indicated correctly, such as misconceived months or years, an incorrect chronological order of collaborators or investors, or a mistaken degree of innovativeness of the venture's products. In some cases, larger inconsistencies or missing data occurred that could not be corrected directly by the survey coordinator. Here, the survey coordinator asked the interviewer either for an explanation or, if no explanation could be given, to call the respondent again in order to clarify inconsistencies or collect missing data. This happened, for example, when the interviewer omitted information about a service provider or an institutional investor, who had been mentioned by the respondent. Most times, such additional information yielded useful data that made it possible to correct for such inconsistencies. In some rare cases, however, major inconsistencies could not be corrected (for instance when it was no longer possible to reach a respondent). In these cases, the corresponding parts of the interview were excluded from the dataset. If the entire interview had major mistakes that could not be corrected (for example a venture active in the wrong industry, or too vague responses by the interviewee), the interview was excluded from the dataset altogether.

For each interview of the FIRES wave, the survey coordinator created an individual feedback file in which s/he duly noted all inconsistencies and adjustments made. As such, the feedback file did not only help data users to keep track of the adjustments made, but also allowed for a continuous training of the interviewers, thereby ensuring that all interviews were completed homogenously. At times, the interviews were conducted by particularly experienced interviewers who had received plenty of training. In these cases, the survey coordinators did not listen into the audio recordings but only clicked through the online questionnaire to look for inconsistencies. In doing so, the survey coordinator followed basically the same procedure as for the interviews that required listening. The only difference was that, for each interview, the survey coordinator kept detailed logs of the email conversations with the corresponding interviewer on top (or instead) of the feedback files. In this vein, clarifications by the interviewers for all types of inconsistencies were stored.

2.6. Data Reliability

Data reliability generally refers to the degree to which a measure of a concept is replicable and stable over time. Anybody following the same measurement procedure should be able to arrive at the same findings, irrespective of individual judgments made by the observers or researchers. While the measures and data collection procedures for the PT dataset have clearly been specified for repeated use, one essential point that could nevertheless have affected data reliability is that the data collected for each venture relies on the responses of one single interviewee. Even though the founders interviewed appeared not to have difficulties to recollect all major events that occurred throughout the venture creation process, the question remains: (How) can we be sure that the responses by this single respondent are accurate and reliable?

To create confidence in the reliability of the founders' responses, we administered two different reliability tests. First, we designed a procedure to assess the *reliability of responses over time* using *follow-up interviews*. For this procedure, 155 founders in Germany and the USA were interviewed twice: first in 2011-2013 and a second time in 2017-2018. During this second interview with the same founders, the same questions were asked. As the questions remained the same, the respective founders were asked to remember events that, in 2017-2018, dated back about five more years than in 2011-2013. Importantly, the interviewees did not receive any assistance or knowledge in relation to the responses they had given during their first interview. Finally, we calculated the overlap between the responses given during the first (2011-2013) and second (2017-2018) interview. Despite the 5-year time gap, responses overlapped for more than 70%. Importantly, the interviewers also reported that differences in the overlap were not to be attributed to a lack of the respondents' memory, but rather to the more limited experience of interviewers during the first wave of interviews.

A second procedure was developed to assess the *reliability across respondents* by contacting *a co-founder* of the same venture. Those interviewees who reported that more than one founder was involved in the set-up of the new venture were asked for the contact details of their co-founders. A few months after the interview with the main founder, 20 co-founders in Italy and the UK were called and asked exactly the same questions about venture creation as the main founder. More concretely, the co-founders were asked to verify the information provided by the main founder, and to recall if any significant information was missing. Subsequently, we again calculated the overlap between the answers by the main founder and the co-founder. We found that in these cases – where the interview with the co-founder took place only a few months after the interview with the main founder – the response overlap was almost 100%.

The results of the two abovementioned reliability tests indicate that the responses provided by the founders interviewed can be considered reliable. Duplicate measures as well as similar procedures designed to tap into the same concepts have produced remarkably uniform results. Those interested in studying early-stage entrepreneurial processes can therefore be assured that the PT dataset contains only reliable and consistent data.

3. Conclusions

To date, the PT database constitutes one of the most complete and reliable databases on venture creation processes. Focusing on activities related to team formation, finance acquisition and product/service development, the database contains precise time-stamped data on a monthly basis. While it is mergeable with other databases, in particularly the PSED study, the PT database is unique with regard to the detailed time-stamped information it provides. Furthermore, it is directly internationally comparative as it traces venture creation processes in Germany, Italy, the USA, the UK, and the Netherlands.

It might be interesting to learn that the more limited number of cases for Italy and the UK were caused by the more limited samples available, in particular for alternative energy ventures. In the UK, entrepreneurs often shied away from setting-up alternative energy ventures because of frequent and, thus, unpredictable regulatory changes. In Italy, on the contrary, entrepreneurs repeatedly indicated to set-up alternative energy ventures, (thus obtained the related subsidies,) but ultimately abstained from executing their plans. Irrespective of any subsidy provisions, venture creation in the information and communication industry was generally more limited in Italy.

Despite the slightly more limited database for Italy and the UK, the PT dataset has been extremely well received by national and international scholars as it is of high quality, that is complete, consistent, and reliable alike. Accordingly, several research collaborations with leading scholars in the field are already pursued.

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Sequence analyses that reveal country-specific typologies of start-up processes and their institutional foundations

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Annex 4 to D5.1 Internationally comparative dataset on start-up processes and their institutional foundations in Germany, Italy, the UK and the US

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1. Executive summary

Sequence analyses can be conducted in different forms. Optimal matching approaches are one of the most widely used forms of sequence analyses. Ever since optimal matching (OM) analyses have been used to decode the human genome, they have become an established method in scientific disciplines as diverse as biology, computer science, and sociology. Given that OM analyses can identify patterns of trajectories characterized by timely ordered events, they are an ideal tool for longitudinal analyses of venture creation processes. Remarkably, though, such studies hardly exist to date. To pave the way, we discuss how sequence analyses can be used in order to analyse venture creation – in particular with a view of country-specific differences. More specifically, we use a unique dataset of 351 venture creation processes to illustrate how founder involvement within venture creation differs across the institutional environment of Germany and the US – also in comparison to other venture characteristics.

2. Sequence analyses that reveal country-specific typologies of start-up processes and their institutional foundations

1. Introduction

Analyses of organizational processes are of paramount interest to organization researchers. Just take the examples of logistic flows, work processes, market developments, selection of job applicants, or venture creation processes. Are there particularly successful or efficient ways of organizing such processes? And, if so, is there a finite set of successful, or unsuccessful, processes – and how do they look like? Answers to such questions are of highest relevance, because they reveal typologies of organizational processes, as well as their timing and drivers. Ultimately, this makes it possible to optimize the respective processes.

To answer questions about how organizational processes unfold over time, longitudinal large-N analyses are needed. One of the most opportune methods to this end are sequence analyses (SA) based on optimal-matching (OM) algorithms. Contrary to traditional quantitative methods investigating temporal dynamics, OM techniques make it possible to treat one sequence of events as one unit of analysis, which enables the calculation of similarity degrees between sequences. Based on their respective similarities, sequences are then grouped into clusters of resembling processes. In this way, the entity of all processes observed is distilled into the most representative set of process types – based on the length, order, and duration of activities taking place. This substantially distinguishes SA from other quantitative dynamic methods in general, and its most viable alternative, event-history analysis in particular, because these methods typically consider one process as multiple stochastically generated events (Abbott, 1995). OM techniques therefore constitute a particularly valuable tool for longitudinal research into process typologies (Aisenbrey & Fasang, 2010).

Despite their potential for analyzing organizational processes, and despite their wide-spread use in sociology (see, for example, Abbott & Hrycak, 1990; Stovel, Savage, & Bearman, 1996; Han & Moen, 1999; Brzinsky-Fay, 2007; Lesnard, 2008), OM techniques have to date hardly been used in organizational research. This “limited application of OM analysis in the management area” has, most importantly, been attributed to “the fact that researchers are often unfamiliar with OM and its potential” (Biemann & Datta, 2013: 52).

Seeking to address this research gap, we illustrate how OM can be applied to the study of venture creation processes. Based on a dataset of 351 venture creation processes, we illustrate how founder involvement in setting-up ventures differ between the different institutional environments of Germany and the US. In order to highlight these differences, we contrast our results to the differences of venture creation approaches between industries, types of goods developed and degree of innovativeness. Our main contribution thereby consists in

illustrating how sequence analyses work and how they allow to discern distinct venture creation approaches.

To illustrate our arguments, the remainder of the paper is organized as follows. Section 2 presents the state of the art of today's SA literature and explains how OM sequence analyses work. Section 3 illustrates how OM analyses can be applied to the study of founder involvement in venture creation. Section 4 presents the results. Section 5 concludes by summarizing our findings and critically discussing the potential of OM analyses for entrepreneurship research.

2. Literature Review: Towards an Application of OM Analyses To Venture Creation Processes

Over the past three decades, OM analyses have become an established method in scientific disciplines as diverse as biology, computer science, and sociology (Aisenbrey & Fasang, 2010). Their potential was first proven in biology at the end of the last century, when OM techniques were used to decode the human genome. Briefly afterwards, several OM variants were applied in computer science, where comparisons of character strings are still at the basis of today's spell checkers – to name just one example. Abbott and Forrest (1986) pioneered the application of OM techniques to social science data by analyzing sequences of dance patterns. Ever since, OM applications have gained momentum in sociological research, where they were chiefly used to investigate career paths and life-course trajectories (see, for example, Abbott and Hrycak (1990), Blair-Loy (1999), Han and Moen (1999), Salvato et al. (2012)).

Despite their initial success, the early applications of OM analysis in sociology did not remain without criticism. Led by Levine (2000) and Wu (2000), the OM opponents criticized that the adoption of this natural-science method to the social sciences was based on limited or unfounded theoretical assumptions.

Challenged by this criticism, the OM proponents further refined sequence analyses (see Brzinsky-Fay, Kohler, Halpin, Lesnard, Aisenbrey, Fasang, Elzinga, Anyadike-Danes, & McVicar, 2010; Liao, 2015). These methodological refinements have had two major consequences. First, a standard way of running OM analyses has crystallized (see Han & Moen, 1999; Abbott & Tsay, 2000; Stark & Vedres, 2006; Biemann & Datta, 2013).

Second, OM analyses have become an established tool in sociology as they offer the following advantages (see Aisenbrey & Fasang, 2010): (I) OM analyses make it possible to map event- and trajectory-based theories. (II) They allow for quantitative measurements of sequence similarity. (III) They are exploratory to the extent that distributional assumptions prior to the analyses are not necessary. (IV) They provide a comprehensive description of process typologies that are part of a broader population. (V) Finally, OM results can be combined with traditional statistical tools, such as multinomial regression analyses, in order to assess which factors influence the process typologies identified.

While OM applications in venture creation research offer the same advantages, they are still exceptional. To pave the way for OM analyses in entrepreneurship studies, we start with briefly illustrating how OM works. In doing so, we follow the dominant approaches used today (see Han & Moen, 1999; Abbott & Tsay, 2000; Stark & Vedres, 2006; Biemann & Datta, 2013). Accordingly, we determine the OM cost functions on the basis of frequency transitions and use Ward's minimum variance method combined with normalized-gamma, silhouette and Calinski-Harabasz validation indexes (Halkidi, Batistakis, & Vazirgiannis, 2001) in order to determine sequence clusters.

Before applying OM techniques to founder involvement in venture creation processes, it seems opportune to briefly explain how OM work: To identify sequence typologies, the majority of OM analyses proceeds in four steps.[2] **First**, the processes under investigation are coded into categorical values in order to describe them as sequences of states and events. A *state* refers to the activity that is taking place at a given moment during the observed process. A state thus indicates, for each time unit, in which situation the process is in. Take the example of a venture creation process, where product development, the acquisition of finance, or the recruitment of employees are examples of states. An *event* is a change of state; for example, when a start-up company ends the period of financial acquisition and begins with product development.

To report real-world processes as sequences of states and events, each state must be characterized by a code that belongs to a set of predefined categorical values, called alphabet. Consider the following example of an alphabet describing venture creation processes: Imagine that, during the start-up phase, venture founders would exclusively develop new products (=P), seek investment (= I), and hire employees (= L). Then, the alphabet of codes reporting this universe of venture creation activities is: *L*, *I*, *P*. Accordingly, *P P I I L* describes a start-up process in which the venture founders focus on product development during the first two time periods (e.g. months), then seek investment for the next two time periods, and finally hire employees during the last start-up period.

In a **second step**, a cost function needs to be determined in order to assess the degree of similarity between two sequences. To this end, optimal matching algorithms determine the costs of converting one sequence into a second one, whereby the states of the first sequence are substituted, deleted, or newly inserted until they resemble the second sequence. Take the example of the two sequences *L I P* and *L L I*. By deleting the initial *L* of the second sequence and inserting *P* at its end, the second sequence becomes equal to the first.

[2] As with virtually all quantitative and qualitative analyses, several variants of running OM analyses exist. A comprehensive overview over these variants has been provided by Aisenbrey and Fasang (2010). Since it is our major aim to illustrate how organization researcher can identify the most opportune coding approaches on the basis of their raw-data characteristics, we base our illustrations on today's standard way of running OM. Given that detailed illustrations of this standard procedure has been provided by Biemann and Datta (2013), we here only sketch the most important steps in order to allow novices to this method to follow our arguments.

Alternatively, the states *I* and *P* of the first sequence could be substituted with the states *L* and *I*. Importantly, the algorithm always chooses the least costly way of transforming sequences or, rather, assessing their difference. This leads us to the question of how 'expensive' substitutions, insertions and deletions are. Should one substitution cost more than another? Should an insertion or deletion cost the same as a substitution?

While several approaches to determining substitution costs exist, Rohwer's (1997) data-driven approach is currently seen as the most valid one and has therefore become today's standard. Rohwer suggests to set costs based on empirical grounds, namely according to the frequency with which events, i.e. transitions from one state into another, occur within a dataset. Accordingly, substitutions of events, occurring more frequently, are less costly – and vice-versa.

Costs of insertions and deletions are set in relation to substitution costs and determine which operation is less costly and, hence, favoured. While substitutions give more weight to the temporal position of states, because they may destroy event patterns but preserve the moments at which processes are in a certain state, insertions and deletions (indels) give more weight to event patterns but not to the moment at which they occur. Consider, for example, the sequences *P P I I L L* and *L L P P I I*. If one indel operation is equally expensive (i.e. if one insertion and one deletion is about half as expensive) as one substitution, the two sequences become equal by applying just two indel operations.[3] If, however, one indel operation is multiple times more expensive than one substitution, then only substitutions are possible to transform one sequence into the other. In this case, the distance between the two aforementioned sequences would be maximal, because each state would have to be substituted with the one of the other sequence.

Consequently, low indel costs motivate the preservation of event patterns by facilitating the addition or removal of states, which may also lead to an increase or decrease in sequence length. Sequence patterns are thus matched regardless of their position in the sequence. High indel costs, on the contrary, favor substitutions and therefore emphasize the temporal position of states. In order to stress the occurrence of events rather than the temporal position of states, we here set indel costs to the minimum value that satisfies the triangular inequality, meaning that deleting and inserting a state is never cheaper than the equivalent substitution.

Having defined the respective transformation costs, the **third OM step** consists in determining the distance between all sequence pairs within a dataset (see Abbott, 1995). To this end, the OM algorithm iteratively minimizes the costs of transforming sequences one into another through substitutions and indel operations. This process ultimately leads to the development of a distance matrix, which reports - for each sequence - how similar, or different, it is from any other sequence in the dataset.

[3] For example, the last two *L* states could be deleted from the first sequence and then inserted at its beginning.

In a **last step**, sequences are grouped into clusters in such a way that compactness and separateness are maximized, meaning that sequence similarity is highest within each cluster (compactness), while sequence difference is highest between clusters (separateness). In order to group sequences, a clustering algorithm is applied. This algorithm uses the distance matrix, established in the third OM step, as an input and places similar sequences with low distance scores into the same cluster, while sequences with high distance scores are placed in different clusters (Witten, Frank, & Hall, 2011). While the choice of 'the best' cluster algorithm is a debate in its own right, Ward's hierarchical clustering method has become the standard approach in OM analyses.

Given that the number of clusters needs to be determined *ex ante*, cluster validation techniques are typically used in combination with cluster analyses to determine the optimum cluster solution. Amongst the broad variety of cluster validation techniques, the normalized-gamma, silhouette and Calinski-Harabasz indicators are part of the most frequently used validation indices (see Halkidi, Batistakis, & Vazirgiannis, 2001). Accordingly, we here use Ward's hierarchical clustering techniques to group the dataset into 2 to 10 clusters and then determine the optimum cluster number by calculating the best average ranking score on the basis of the normalized-gamma, silhouette and Calinski-Harabasz rankings.

3. Methodological Approach: How To Investigate Founder Involvement in Venture Creation Processes

To illustrate how OM techniques can be applied to venture creation research, we here focus on the involvement of founders during the start-up phase of their ventures. When setting up a venture, founders face two fundamental questions: First, they need to decide about how much time they are willing and able to invest in venture creation. It is thereby especially important to find the right moment for giving up a previous job in order to change from a part-time (PT) to full-time (FT) commitment. Second, they need to decide whether it is opportune to set-up the new venture alone or together with a team of co-founders who provide a more diverse skill basis. Naturally, this decision implies that the founder cannot retain the complete control over all start-up decisions, but needs to share it with his co-founders.

Obviously, there is not 'one best way' of founder contribution to venture creation. There are many (Gartner, Shaver, Carter, & Reynolds, 2004). Importantly, previous research illustrates that these decisions are influenced by the circumstances in which venture creation occurs, most notably the flexibility of a country's labour-market institutions (Baughn, Sugheir, & Neupert, 2010). Accordingly, founders in the US with its flexible labour-market institutions were shown to approach venture creation in different ways than founders in Germany with its regulated institutional environment (Held, Herrmann, & van Mossel, forthcoming 2018). Additional factors that were found to influence founder involvement are a venture's industry (Dencker, Gruber, & Shah, 2009), the type of product or service developed

(see Gartner, 1985), and the venture's degree of innovativeness (Beckman, 2006). Accordingly, we here use OM analyses to illustrate how founder involvement differs across the institutional setting of different countries and – in comparison – between industries, the type of good produced, and its degree of innovativeness.

Our analyses are based on the 'perfect timing' database as this dataset currently offers the most complete insights into how successful entrepreneurs proceeded when starting their own ventures. The database was collected between 2011 and 2014 at the Innovation Studies Group of Utrecht University in collaboration with Columbia University (New York). The dataset contains 423 cases overall, including start-up processes in Germany, and the US. Amongst all 423 start-up cases included in the dataset, our analyses are based on those 351 success cases of start-ups that achieved sustainable profits at the end of the venture creation. Unsuccessful cases of bankruptcy were excluded for the purpose of our analyses. While all 351 success cases are included in the analyses, we graphically report venture creation processes only for the first 75 months of venture creation for practical reasons.

To illustrate different team formation approaches during the venture creation process, we proceeded as illustrated in section 2: Accordingly, we conducted sequence analyses based on optimal matching techniques, whereby we determine substitution costs on the basis of transition matrices. This allows us to determine how similar each process is to every other process in the sample. These sequence analyses are combined with cluster analyses, whereby we use the standard clustering approach, i.e. Ward's hierarchical clustering combined with normalized-gamma, silhouette and Calinski-Harabasz validation indices. With regard to cluster analyses, we determined the optimum number of clusters on the basis of the entire dataset. Thereby, we only report clusters of more than 10 cases. Clusters including less than 10 cases are considered to be outliers and, thus, not reported.

4. Results: Differences in Founder Involvement in Venture Creation Processes Between Countries and Other Venture-Creation Circumstances

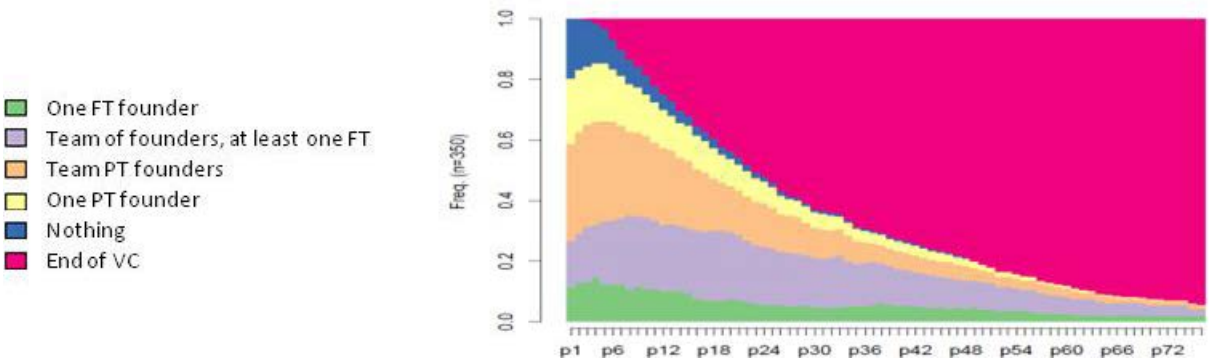
The results of the aforementioned analyses are reported in the form of graphs. These graphs display the length of the venture creation process on the x-axis, whereby the time units report the number of months that have passed since the start of venture creation. This start is defined as the first time that one of the founders discussed the idea to set up the venture. The corresponding end of the venture creation process is defined as the first time that the new venture made sustainable profits. However, as already mentioned above, we depict venture creation processes only until month 75 in order to improve readability.

The y-axis, in turn, represents the share of ventures which find themselves in a certain state, i.e. undertake a specific activity, at a given point in time. These states are represented by a color code for each of the three areas of team formation. In doing so, two states (color codes) are present in any of the following graphs: namely the "end of the venture creation"

and “nothing” happening, meaning that the founder is not undertaking any activity in the respective area of team formation after having discussed the start-up idea with another person.

The data about founder involvement in the start-up process [Graph 1] reveals that about half of all observed ventures start out as a team effort (*purple, orange*). Out of these ventures founded by a team, more than 2/3 are started by a team of PT founders (*orange*), whereas in the rest of the cases at least one member of the team works FT on the venture (*purple*). A similar pattern is observed amongst the ventures created by a single founder (*green, yellow*). Individual efforts make up 30% of the overall sample, out of which 2/3 worked exclusively PT (*yellow*) on their venture. The remaining 20% of ventures are not being actively developed by their founders after the latter had discussed the start-up idea with another person (*blue*). Over the course of the first 6 months, the share of inactive ventures and those managed by individuals in FT (*green*) decreases, whereas a larger percentage of team efforts, both PT and FT, can be observed.

Graph 1: Founder Involvement – All Ventures Observed (N=350)



When we break this data down **by country** [Graph 2, Aggregate Data], clear differences between the two countries emerge. In comparison to the overall sample [see Graph 1], ventures in Germany are more likely to be created by a team of PT founders. This can be interpreted to the extent that Germany’s rigid labour-market institutions make founders reluctant to engage in venture creation full-time at an early stage: Founders in Germany are only willing to give up their previous job and engage in venture creation full-time once they see good chances for their venture to generate sustainable profits. In contrast, the flexible labour-market institutions of the US drive founders to start their venture in full-time early on.

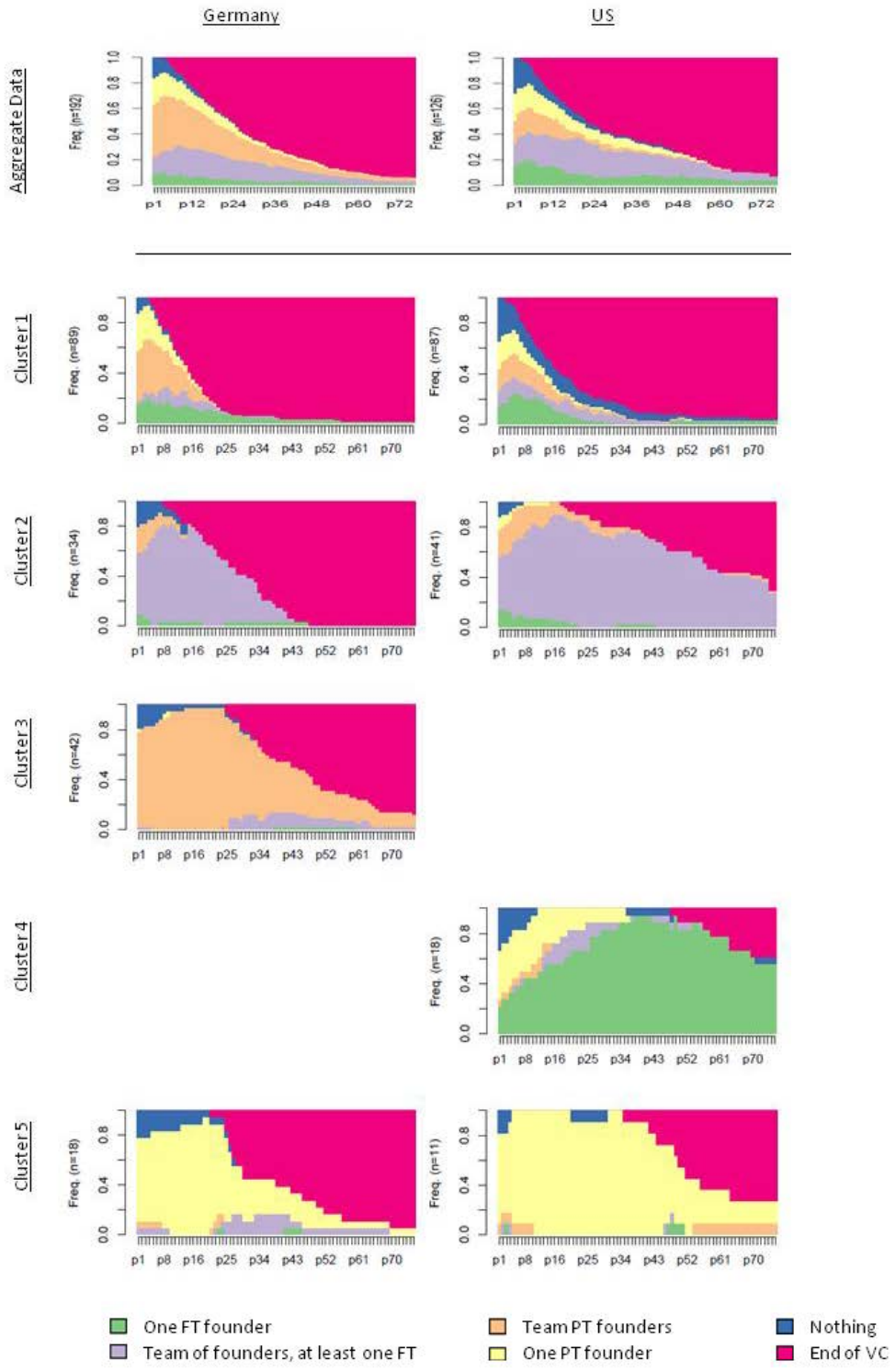
While these are important differences of founder involvement at the country level, they tell us little about the most typical approaches of founder involvement *within* each country. In order to gain more in-depth knowledge on country-specific approaches, we cluster the data as described above. These analyses reveal that one approach is common to all three countries [Graph 2, Cluster 1]: namely a founding process characterized by a short process

duration. However, the differences within this short process are quite pronounced between countries. While in the US a relatively high level of inactivity persists throughout the beginning of venture creation, founders in Germany set out to work right away after they discussed the start-up idea with another person. This indicates that Germany's founders tend to start the venture creation process only once they are convinced of the venture's eventual success.

In addition, US and German founders resemble each other in two other start-up approaches they take. As illustrated by Graph 2, cluster 2, one approach consists in co-founding the venture whereby at least one founder dedicates his full-time capacity to venture creation. Interestingly, though, the length of this process is decisively longer in the US than in Germany [Graph 2, Cluster 2]. The second approach consists in individual part-time founding [Graph 2, Cluster 5].

Finally, one country-specific start-up approach can be observed both among German founders and among their US counterparts: While German founders create their venture with a team of PT founders [Graph 2, Cluster 3], US founders have a tendency to set up their start-up company on their own and on a full-time basis. [Graph 2, Cluster 4]. This supports the idea that Germany's rigid labour-market institutions make founders more cautious with regard to early time commitments in venture creation, whereas labour-market flexibility motivates superior engagement in venture creation early-on.

Graph 2: Founder Involvement – Country-Specific Approaches

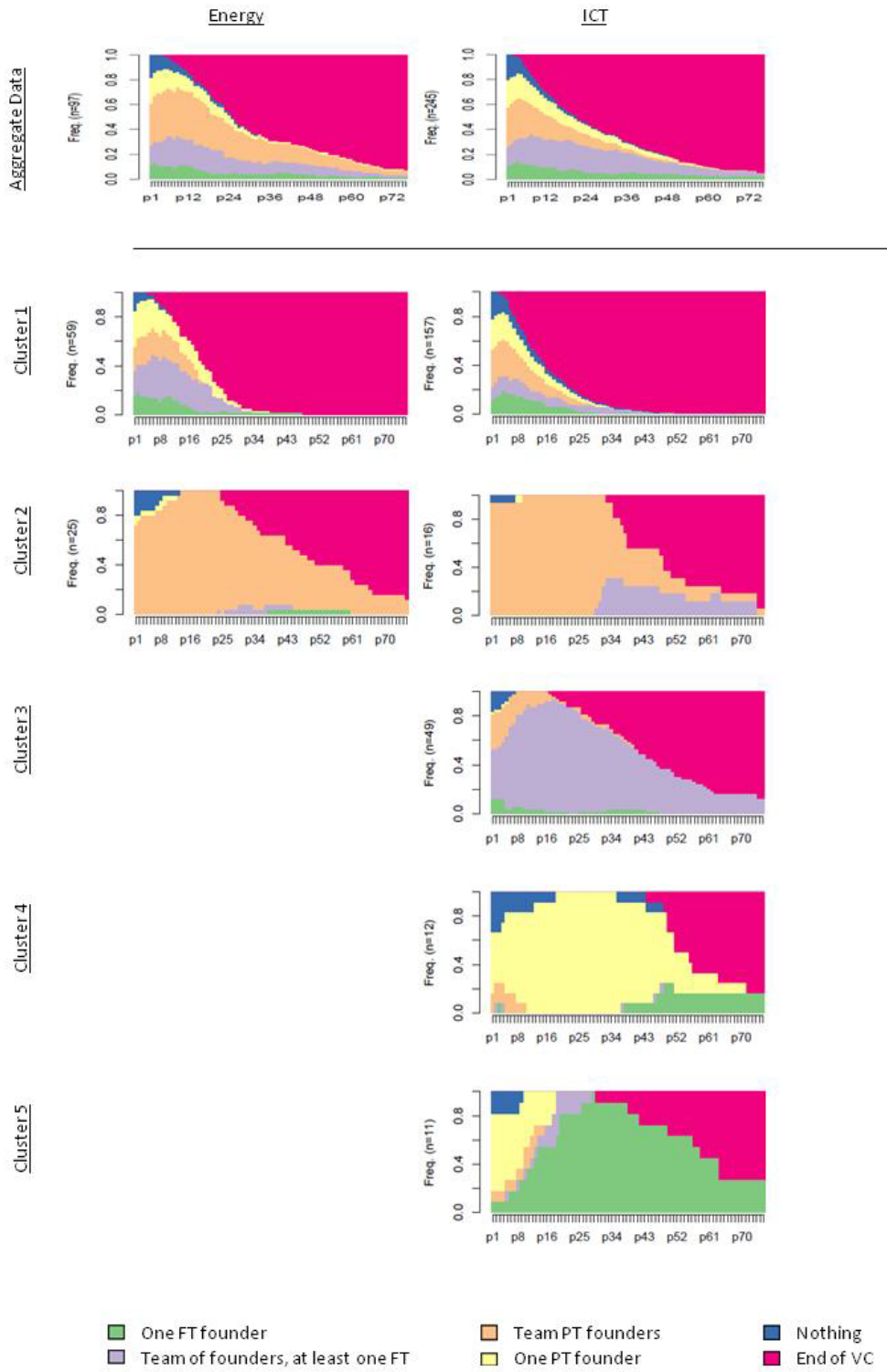


A split of the overall dataset **by industry** reveals that founder involvement differs fundamentally between the IT (information and communication technology) and the ET (environmental technology) sectors [Graph 3]. Founding processes in the ET sector end, on average, at a later point in time than ICT start-up processes [Graph 3, Aggregate Data]. This pattern is likely to be caused by the highly complex regulation of the ET sector, which entails that founders need to go through lengthy approval processes in order to obtain the ET permits needed for starting the new ventures. Accordingly, the ET sector is also characterized by a significantly larger share of ventures that are created by PT founders.

When breaking this aggregate data down for each industry with the use of cluster analyses, the results illustrate that two approaches are common to both industries: n8amely, first, a short process of founder involvement [Graph 3, Cluster 1]. The second approach consists in venture creation processes that are mainly driven by a team of part-time founders [Graph 3, Cluster 2]. Interestingly, the latter is much more common in the ET sector (26%) than among ICT ventures (7%).

In addition, three start-up processes exist that are particularly typical only for founders of ICT ventures. More concretely, these are founder-involvement processes centered around teams with at least one FT founder, processes advanced by a single PT founder, and processes driven by FT founders [Graph 3, Clusters 3-5]. Interestingly, founders of ET ventures do typically not pursue any of these three approaches when starting their ventures.

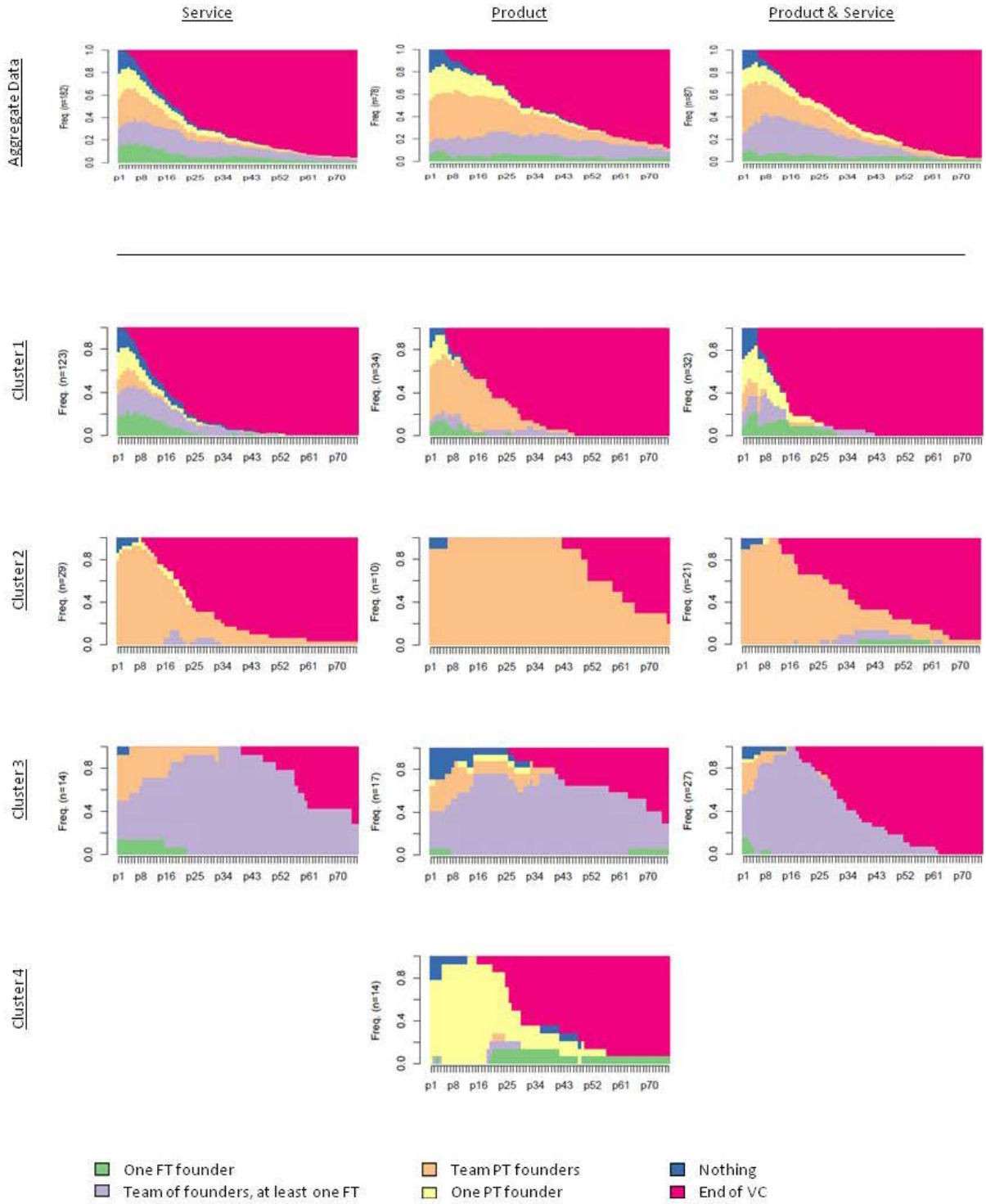
Graph 3: Founder Involvement – Industry-Specific Approaches



The ‘perfect timing’ database also allows us to distinguish founder involvement in venture creation processes depending on **the nature of the developed good** [Graph 4]. Hence, we are able to identify whether founder involvement differs for ventures that develop services, or products, or both. Our analyses of the overall dataset clearly show that, on average, the road to success is longer for ventures developing products, or both services and products, than for ventures developing services only [Graph 4, Aggregate Data]. The reason for this seems straight-forward: It, simply, takes longer to develop products than services. It is furthermore interesting to note that the percentage of ventures set-up by a team of PT founders is significantly higher in product than in service ventures. Service ventures, in contrast, are more frequently set up by individual FT founders.

We, again, disaggregate the overall dataset with cluster analyses in order to discern the most typical founder approaches depending on the venture’s good developed. We find that three approaches of founder involvement are particularly typical for each type of good developed [Graph 4, Clusters 1 – 3]. They are: processes of short founder involvement [Cluster 1], processes that are chiefly driven by a team of PT founders [Cluster 2], and processes driven by a founder team with at least FT founder. Interestingly, founders of product developing ventures tend to pursue one additional approach to venture creation [Graph 4, Cluster 4], which consists in setting-up the new venture alone and on a part-time basis.

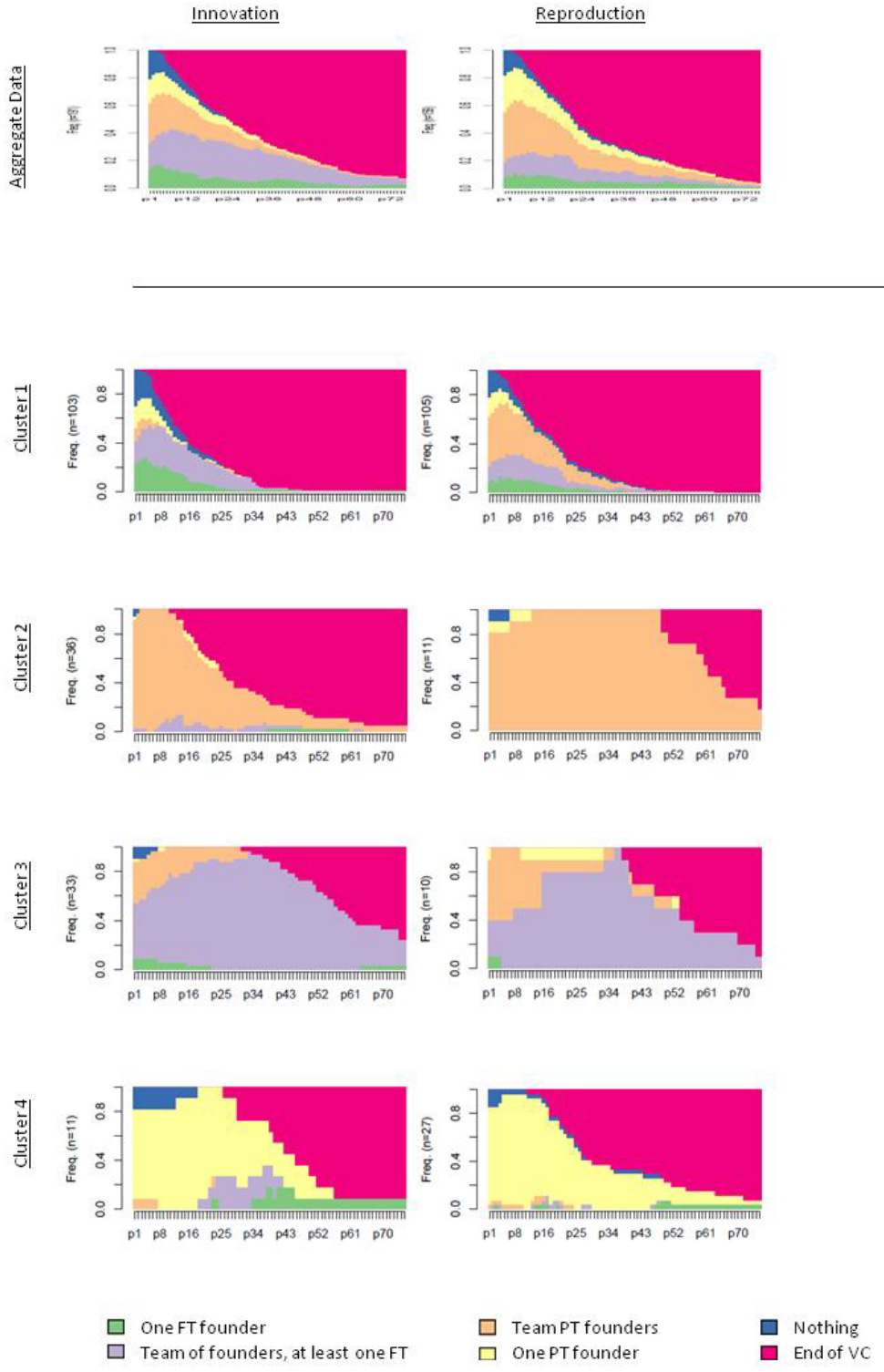
Graph 4: Founder Involvement – Approaches Specific to the Nature of Good Developed



Lastly, we differentiate between **reproducing and innovating ventures** [Graph 5]. At first sight, the analyses conducted on the basis of the overall dataset do not show substantial differences between ventures of either type with one exception: Innovative ventures are more frequently established by a start-up team involving at least on FT founder [Graph 5, Aggregate Data].

With the help of cluster analyses we obtain the same four approaches to venture creation for founders starting innovative and reproducing start-ups [Graph 5, Clusters 1 – 4]. Interestingly, though, the distribution of cases over these four clusters differs significantly: Innovative ventures are much more likely than reproducing ventures to be set up by a team of founders [Graph 5, Clusters 2, 3]. The respective share of cases grouped in founder team driven clusters 2 and 3 is 17% for innovative ventures compared to 7% reproducing ones. The focus on team founding processes by innovative start-ups can be explained by the fact that innovative products require a more diverse skill basis than the imitation of products. And the necessary skills are more readily found in teams. The opposite holds true for start-ups developing product imitations. Often, these ventures are set-up by individual PT founders (17% of cases in cluster 4), whereas this founding type is comparatively rare among innovative ventures (6% of cases in cluster 4).

Graph 5: Founder Involvement - Approaches Specific to the Degree of Innovativeness



5. Conclusion

Our paper seeks to further pave the way for OM based sequence analyses in venture creation research. To this end, we have both explained the method and shown how it can be applied to the involvement of founders in venture creation processes. The most important lesson to be learned from our analysis is that founding processes are by no means homogenous. As demonstrated above, founder involvement heavily depends on a venture's specific setting. Hence, entrepreneurs looking for advice on how to best establish their own venture should first assess their specific circumstances of venture creation. Accordingly, our analyses have shown that important circumstances influencing the venture creation approaches chosen by founders include a venture's country, its industry, nature of good and degree of innovativeness.

Importantly, our findings also have implications for policy-makers. In particular, the insight that different ways to successful venture creation exist between countries serves as a reminder that the idea to recreate Silicon Valley in Europe might not be most effective to foster entrepreneurship. Rather, tailor-made policies are needed for each country to support founders in the respective countries to successfully start their ventures.

While mastering OM sequence analyses is certainly not without challenges, we wish to conclude by highlighting the potential of this method. Across the social sciences, calls for longitudinal, analyses have steadily increased over the past decades. While time series regressions, history-event analyses, and several other tools have been developed in answer to these calls, OM analysis still constitutes the only method that is able to assess processes in their entity. Such longitudinal OM assessments offer the additional advantage that they can be combined with traditional statistical tools, such as cross-tab analyses or multi-nomial logistic regressions in order to identify the determinants of the cluster results obtained (for an example, see Salvato's (2012) study of CEO careers). While the potential of OM analyses for venture creation studies is thus massive, the time investment necessary to master this method is manageable. We therefore expect OM analyses to become an integral part of the methodological toolkit of organizational researcher in general, and entrepreneurship scholars in particular.

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Team Formation Processes in New Ventures

Abstract

The political economy literature on 'Varieties-of-Capitalism' demonstrates that, and how, the composition of a firm's human resources is shaped by national labour-market institutions. As these institutions drive firms to pursue human-resource strategies, in line with the comparative advantages offered, systematic differences exist between countries in the skill profiles of corporate workforces.

Importantly, though, this causal link has only been established for incumbent firms, whereas the process of skill composition in start-up ventures remains understudied. While entrepreneurship research theorizing about the team formation in start-up ventures exists, such studies mostly focus on different outcomes of team formation, for example the number of employees. Questions about how team formation processes unfold and the factors, such as labour-market institutions, influencing their evolvement remain unanswered.

To address this research gap, we analyze the venture creation processes of 344 ventures in Germany and the US, offering particularly typical examples of countries with regulated and deregulated labour-market institutions respectively. Based on optimal matching techniques, we illustrate how team formation processes differ over time in terms of founder and employee involvement and the hiring of service providers. Furthermore, we use binary logistic regressions to identify the extent to which national labour-market institutions account for these differences.

Keywords and JEL-classification

Keywords: New Venture Creation; Team Formation; Entrepreneurship; Varieties-of-Capitalism; Optimal Matching; Labour-market Institutions;
JEL Classifications: L26; M13; M54

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1. INTRODUCTION

With his seminal article "Who is the entrepreneur is asking the wrong question", Gartner (1988) initiated a new paradigm in entrepreneurship research. Instead of focusing on the characteristics of entrepreneurs, scholars began to research the entrepreneurial process. While it is now widely accepted that entrepreneurship is a process that unfolds over time rather than a singular act, different conceptualizations of the process have emerged (Moroz and Hindle 2012). We here follow the conceptualizations of entrepreneurship as the process of venture creation (VCP), a conceptualization now considered to be central to entrepreneurship research (Davidsson and Gordon 2012).

Among those who understand entrepreneurship as the creation of ventures, a variety of ways to define and operationalize VCPs exist and our knowledge about it remains limited (Samuelsson and Davidsson 2009). The literature on VCPs and venture growth has produced a variety of perspectives on how ventures are created, of which the two most prominent ones are stage based models and activity based models (Moroz and Hindle 2012). Stage based models postulate that all ventures, just like organisms, go through the same, predetermined stages in their development (Levie and Lichtenstein 2010). Hence, the underlying concept of VCPs is a passive one that assumes a 'natural', almost automatic progression through the different stages, thereby putting little emphasis on the activities and choices of the entrepreneur. In contrast, activity-based models conceive a VCP as the number and sequence of singular gestation activities occurring throughout the VCP (Carter et al. 1996). The result is a rather active VCP concept explicitly focusing on the actions of the entrepreneur. In fact this approach defines the VCP as the accumulation of singular activities that the entrepreneur chooses to undertake from an eclectic list of gestation activities. Despite these substantial differences, neither perspective has yet produced a coherent, widely accepted conceptualization of the VCP (Davidsson and Gordon 2012; Levie and Lichtenstein 2010).

The most recent literature on venture creation argues that this conceptual failure has methodological origins: Existing studies do not analyze the VCP as the unit of analysis but rather treat

entrepreneurship as a linear succession of distinct stages or a number of singular gestation activities (Garnsey et al. 2006; Hjorth et al. 2015; McMullen and Dimov 2013). This often leads to the use of methods not optimal for studying processes (Gordon 2012; Langley et al. 2013; Van de Ven and Engleman 2004): More concretely, Aldrich (2001) distinguishes between outcome-driven (or variance) explanations and event-driven (or process) explanations. While variance-driven studies are suitable to explain change through deterministic causation, event-driven studies consider every action and how they form one process unit (Poole et al. 2000). Because the vast majority of publications have employed variance explanations, they are able to answer questions about antecedents and outcomes of the entrepreneurial process, but little progress has been made to explain how said process unfolds (Ruef 2005; Van de Ven and Engleman 2004).

Furthermore, it has been argued that important heterogeneities between different ventures and venture creation contexts make it difficult to uncover patterns in VCPs. In order to be able to produce meaningful descriptions of VCPs, different characteristics of ventures, as well as the context of their creation, need to be taken into account and controlled for (Gartner and Shaver 2012; Samuelsson and Davidsson 2009).

Taken together, the different literature strands on VCPs thus provide inconclusive results about whether VCPs are 'order or chaos'. Yet, this question has become ever more important in view of the increasing number of countries that implement policies to stimulate economic growth through entrepreneurship. While the differences in the level of entrepreneurial activity between countries are well documented, the lack of knowledge about VCPs means that we do not know whether the processes underpinning entrepreneurial activity also differ between countries. We need to understand if, and how, national institutions shape VCPs in order to decide whether one optimal blue print for the stimulation of entrepreneurship exists, or whether entrepreneurship policies have to be adapted to VCPs shaped by national institutions.

In order to address this research gap, we focus on the most essential process within venture creation, namely the one of team formation (TFP). The process of team formation describes the assembly of a venture's most crucial resource: human capital. A great number of studies have found that the human capital embodied by a venture's founders is the most significant predictor for a venture's survival and growth (Bates 1990; Bosma et al. 2004; Colombo and Grilli 2005; Cooper et al. 1994; Delmar and Shane 2004). Building on these insights, recent studies on team formation argue that employees contribute in similar fashion to a venture's human capital and subsequently its survival (Coad et al. 2016; Dahl et al. 2015; Koch et al. 2013; Weber and Zulehner 2010). Consequently, we conceptualize the team formation process as the time commitments of founders, employees and service providers at any time between inception of the venture and the point it reaches profitability or exits.

Accordingly, our research addresses the above gaps in the VCP literature by asking:

Do distinct types of team formation processes exist, how do they differ and which structural characteristics can explain these differences?

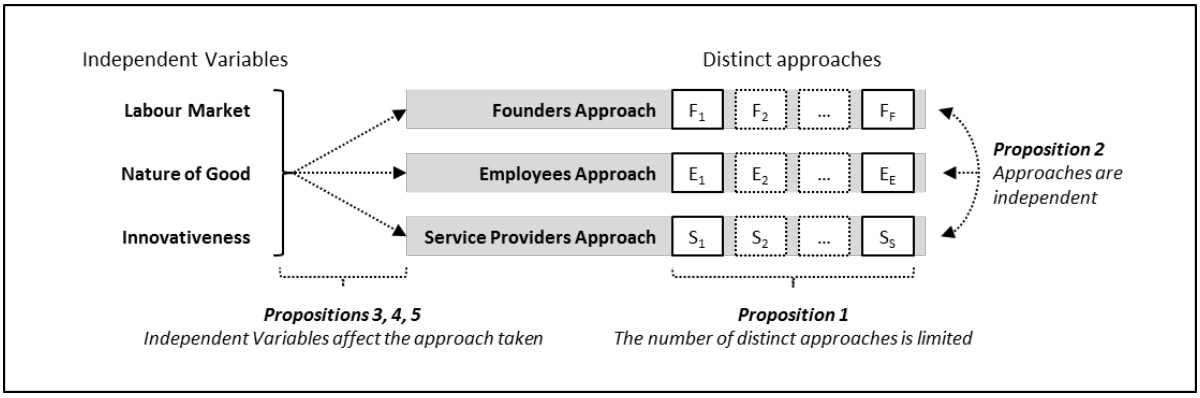
Our paper answers these questions by taking a new methodological and empirical approach: We apply optimal matching (OM) and clustering techniques to the novel data of the 'Perfect Timing' dataset, reporting the venture creation processes of 344 start-up ventures on a monthly basis. Owing to OM analyses and clustering techniques, we are able to study entire VCPs as the unit of analysis and thus, to explore distinct team formation processes on the basis of the team formation activities undertaken, their timing and duration.

In summary, these OM analyses demonstrate that team formation is 'order' rather than chaos as distinct temporal patterns of team formation exist with regard to the time commitment of founders as well as the extent to which employees and service providers are hired. Importantly, we are able to explore a distinct number of approaches for each of these three team-formation dimensions. Furthermore, correlation and regression analyses illustrate that the approaches in one dimension are only weakly correlated to the approaches of the two other dimensions: We observe additivity effects between founder involvement and employee hiring, while the data indicates that substitution effects exist between the hiring of employees and service provider engagement. Finally, binary logistic regression analyses reveal that structural characteristics, in particular the venture's institutional environment and innovativeness, influence which team formation approach is pursued.

To illustrate these findings the paper proceeds as follows: In section 2, we begin with a short review of the literatures on entrepreneurial processes in general and team formation in particular. In doing so, we highlight the opposing views of the stage-based and activity-based approaches. In section 3, we present the data and methodology employed, while we present our results in section 4. In section 5, we discuss these findings and their limitations in the context of previous research and the methodology used. Importantly, we also reflect on the opportunities for future research based on OM techniques.

2. THEORY

In the following section, we introduce the theoretical building blocks required to explore team formation processes in ventures. As illustrated in Graph 1, we summarize in a first step, the literatures discussing different types of team formation. Focusing on its three core dimensions – founder, employees and service provider involvement – we formulate *Proposition 1*: that distinct types of team formation exist for each dimension. With that in mind, we review in a second step, the literature that discusses possible interdependences between approaches (*Proposition 2*). In a last step, we review the literatures on possible influences of structural characteristics upon team formation, in particular labour-market regulation, nature of the venture's good and innovativeness (*Propositions 3 -5*).



Graph 1: Theoretical Building Blocks of Team Formation Processes

What do the different literature strands on team formation processes (TFPs) teach us about how these may evolve? Is team formation random or evolving along systematic trajectories? The *stage based literature* was the first to address this question. Here, venture creation in general, as well as team formation in particular, are commonly depicted as a series of prescribed stages (Levie and Lichtenstein 2010; Phelps et al. 2007). With regard to team formation, many stage models describe a process of continuous growth which, in the beginning, is centered on the role of the founder(s). Kazanjian and Drazin (1990) and Kaulio (2003), for example, posit that, during the first stage of venture creation, the founder(s) work on a prototype or idea. Once the prototype has been created, more founders or core employees join the team in order to work on the products' commercialization during the second stage. Once a commercially viable product has been created, the venture enters into the stage of growth, during which more employees and service providers join to the team. Hence, team formation is described as a linear process during which the team grows from one to many founders who increasingly hire employees as time goes by.

The *gestation activity literature* instead portrays team formation as non-linear processes which are characterized by a variety of activities such as organizing the founder team, switching between part- and full-time work and hiring employees, all of which can occur at different moments (Carter et al. 1996; Gatewood et al. 1995; Reynolds and Miller 1992). While these studies establish that more than one team formation process exists, they only provide snapshots into the frequencies with which different team formation activities take place at different moments of the process.

To give some examples, Gartner et al. (2004) analyze the first start-up activity carried out by new ventures and find that only few ventures start with activities related to team formation, such as 'organizing the start-up team' (6%), getting 'devoted full-time' (2%) or 'hiring employees'(<1%). Another study investigates the sequence of individual start-up activities, distinguishing between successful, interrupted and ongoing venture creation processes: In this study, Carter et al. (1996) illustrate that the majority of successful ventures organize the founder team in the second quarter after venture inception, while at least one founder switches to full-time work at the same time. In the following quarter, the first employee is hired. In contrast, founders who give up on venture creation

mostly organize the founder team in the first month after inception, but wait for one year before switching to full-time work. By contrast, founders of unsuccessful ventures, characterized by ongoing venture creation processes, organize the founder team in the second quarter after venture inception but never switch to full-time work, nor hire any employees.

In summary, while some scattered evidence exists, systematic insights into how team formation evolves over time with regard to founder involvement, the hiring of employees or other types of labor are still missing (Gordon 2012; Jaspers and Hak 2013). That said, it is interesting to note that the activity-based literature agrees with the stage-based literature in that team formation process are not random but follow distinct patterns. Yet, contrary to the stage-based literature, the activity-based literature holds that these patterns do mostly not follow a linear growth process and are context-dependent (Gartner and Shaver 2012; Liao et al. 2005).

Beyond the stage- and activity-based literatures, various research strands provide insights into individual aspects of team formation without explicitly positioning their findings within the overall team formation process. These aspects include: the development of founder teams, the time commitment of founders including part-time entrepreneurs as well as their transition to full-time entrepreneurship, the hiring of employees, and the engaging of service providers.

Those few studies that analyze the development of founder teams illustrate that founder exit is more likely than founder entry throughout the TFP (Hellerstedt 2009). Furthermore, the initial number of founders seems to influence subsequent founder exit and entry. However, the exact effect remains unclear: While some authors argue that the likelihood of founders exiting or additional founders joining the team is higher for bigger teams (Chandler et al. 2005; Hellerstedt 2009), others observe the opposite effect (Ucbasaran et al. 2003). Yet researchers, investigating founder team development, largely concur in their observation that the number of founders overall remains stable throughout the TFP in most ventures (Hellerstedt 2009).

A further research strand, known as the literature on part-time or hybrid entrepreneurship, illustrates that not only the number of founders can vary throughout TFPs, but also their time commitment. Wennberg et al. (2006) were one of the first to argue that that besides the traditional dichotomy of being an employee or a full-time entrepreneur, the possibility of creating a venture in part-time exists. Several empirical studies show that a significant amount of founders actually choose to do so, whereby the exact amount of part-time founders (or hybrid entrepreneurs) varies strongly between countries. In Germany, for example, 64% of ventures created in 2013 were set-up by part-time founders (Metzger 2014). The opportunity to test one's own abilities as a founder, while reducing the financial and labour-market risks related to full-time entrepreneurship, is mentioned amongst the most important motives for part-time entrepreneurship (Folta et al. 2010; Raffiee and Feng 2014).

More recent studies on hybrid entrepreneurship show that entrepreneurs do not necessarily remain part-, or full-time entrepreneurs for the entire duration of the TFP, but increase or decrease their time

commitments throughout the TFP (Block and Landgraf 2016; Folta et al. 2010). For example, Block and Landgraf (2016) find that 20% of full-time founders in their study of German founders initially started out as part-time founders, whereby it remains unknown when these switches from part-time to full-time entrepreneurship occurred.

Even though considered a key decision for young ventures, surprisingly little is known about the hiring of employees (Cardon and Stevens 2004). One problem is that most studies exploring the initial size of ventures ignore (very) small ventures which arguably make up the vast majority of ventures. Consequently, only scattered evidence exists about the extent and timing of employee hiring. The study by Melillo et al. (2013) on Swedish ventures in knowledge-intense industries (1994-2001) encompasses ventures of all sizes, including one-person ventures. It comes to the conclusion that 93% of ventures do not hire any employee during the first year of their existence. The remaining 7% of ventures involve one (5.3%), two (.89%), three (.4%) or 4 or more employees (.54%) during the same time span. Following Swedish ventures created in 1998 over the first 2 years of their existence, Delmar and Shane (2003) report the following development of average employee number: At their inception, ventures hire an average employee capacity of .17 FTE, which increases over the following six months to .51 FTE. In month twelve, the average employee capacity hired further increases slowly to .73 FTE, before jumping up to 3.2 FTE in month 18. Interestingly, the average employee number hired then drops to 1.62 FTE in month 24, i.e. the last observation point. Finally, the findings of (Cooper et al. 1989) illustrate that US ventures which in the first year hire three employees or less grow more strongly during the remaining TFP, both in relative and absolute terms, than ventures that start out with more employees.

The existing evidence regarding the involvement of external service providers in team formation is even more scattered than for the hiring of employees, whereby scholars agree about the importance of service providers as an external source of labour: Cassar and Ittner (2009) demonstrate that a large number of new ventures in the US engage, or plan to engage, accountants (64%) and lawyers (46%) in their quest for profitability. At what point in the TFP the initial engaging of accountants occurs seems to strongly coincidence with events like initial sale or opening of the ventures bank account. Furthermore, Bennett et al. (1999) show that small and medium sized companies in the UK tend to make use of multiple external service providers and that the use of external service providers is positively related to the number of employees: The higher the number of employees, the more likely that a service providers is engage. Cooper et al. (1989) come to the same conclusion in the US context.

While the existing studies provide valuable insights into TFPs, indicating that team formation in ventures is neither chaos nor unidimensional order, it remains unclear what and how many, distinct approaches to TFP exist, and what they look like. Based on the available evidence on TFPs, we expect that:

Proposition 1: *distinct types of team formation rather than unsystematic approaches exist in which (a) founders commit themselves to venture creation, (b) employees are hired and (c) service providers are engaged during the venture creation process.*

If we are right in that team formation processes follow distinct pathways with regard to founder involvement, employees hiring, and the engagement of service providers, the question arises of how do these three channels relate to each other. Does the way in which founders contribute to venture creation influence the extent and timing of employee hiring and service provider engagement? And does the hiring of employees correlate with the engagement of service providers: For example, can we observe substitution or additive effects with regard to the involvement of internal labour (founders and employees) and external labour (service providers) throughout the TFP? Or are the approach to founder involvement, employee hiring and service provider engagement unrelated to each other?

While specific research into the relationship between founder, employee and service provider involvement during venture creation does not exist, different and often contradicting approaches to aggregate team formation have been described in the literature. On the one hand, studies describe additive effects in high-growth ventures where higher founder commitment co-occurs with extensive employee growth and service provider engagement (Cooper et al. 1989; Reynolds and White 1997). On the other hand, scholars observe substitution effects in ventures with growth aspirations between the hiring of employees and engaging service providers as ventures try to avoid high ancillary wage costs and employee protection (Román et al. 2011).

In line with these insights, we expect that

Proposition 2: *(a) the time commitment of founders and the hiring of employees is additive, while (b) the time commitment of founders and service providers is not related, whereas (c) the hiring of employees and service providers is substitutive throughout the venture creation process.*

Should we be able to identify systematically different approaches to founder, employee, and service provider involvement during venture creation, the question arises how to explain which approach is chosen: Under which conditions do founders engage in one rather than another way of setting up their venture? And under which conditions do they hire no, some, or many employees and service providers respectively? In other words, which influence does a venture's context and its characteristics have on the approaches chosen towards team formation? A wide variety of VCP studies have pointed out, that part of the struggle to establish coherent patterns in VCP stems from the negligence of differences in the context and characteristics of the studied ventures (Gartner and Shaver 2012; Ruef 2005; Van de Ven and Engleman 2004). Among the most prominent factors identified in the entrepreneurship literature are: national institutions, a venture's innovation strategy and the type of product developed (Ruef 2005; Samuelsson and Davidsson 2009).

To begin with, the influence of *national institutions* on venture creation processes (in our case the influence of labour-market institutions on team formation processes) the 'Varieties-of-Capitalism' (VoC) literature has long established that companies follow distinct human resource approaches as a reaction to different types of labor-market regulations (Estévez-Abe and Iversen 2001; Hall and Soskice 2001a; Herrmann and Peine 2011). Other than a recent study by Dilli et al. (2018) these studies focus on incumbent firms rather than start-up ventures, their reasoning however is compatible with various entrepreneurship studies on how the rigidity of national labor-market institutions may influence team formation in new ventures.

With regard to institutional influences on founder involvement, real-options theory assumes that an individual will choose entrepreneurship over dependent employment if the potential rewards of starting a venture outweigh the related risks (Wennberg et al. 2006). In line with the reasoning of the VoC literature, this implies that strong employment protection – in the form of strong unions, centralized wage bargaining, long notice periods and limited reasons for dismissal – makes dependent employment more attractive vis-à-vis entrepreneurship (Wennekers et al. 2005). At the same time, strong labor-market regulations also makes the hiring of employees relatively more costly for entrepreneurs which, in turn, makes entrepreneurship less attractive (Henrekson et al. 2010; van Stel et al. 2007). Both effects imply that the level of certainty about a venture's profitability has to be higher in rigid labour-markets than in liberal ones for prospective founders to give up their jobs in favour of committing themselves to venture creation (Román et al. 2013). One way of increasing certainty about one's entrepreneurial abilities and the venture's profitability, without giving up the benefits of dependent employment, is part-time entrepreneurship (Raffiee and Feng 2014). Hence, part-time entrepreneurship seems more likely in regulated than in flexible labour markets.

With regard to institutional influences on employee hiring, the VoC reasoning is compatible with the insights of several entrepreneurship studies: that rigid labor-market institutions reduce a venture's growth ambitions and the extent to which employees are hired (Baughn et al. 2010; Bosma and Levie 2009): Strong employment protection reduces the venture's flexibility to dismiss employees in response to changes in the business environment or in case of low employee performance (Estévez-Abe and Iversen 2001; Hall and Soskice 2001b). This, in turn, increases the risks of hiring employees (Davidsson and Henrekson 2002; Henrekson et al. 2010). Accordingly, Bornhäll et al. (2016) point to the Swedish case, where employment protection (in this case exemptions from the last-in/first-out principle) becomes more severe once a venture employs more than 10 workers: Accordingly, the authors illustrate that the likelihood of hiring employees decreases significantly once ventures come close to this threshold which, in turn, illustrates the negative influence of rigid labour-market institutions on employee hiring.

Similarly, labour-market institutions have been found to influence the attractiveness of engaging external service providers compared to employees. Based on a principal-agent model, Parker (2010)

illustrates that rigid labor-market institutions increase the tendency of firms to hire external service providers in order to circumvent employment constraints, such as payroll taxes. In line with these findings, Román et al. (2011) show that rigid labor-market institutions encourage companies to re-hire employees as self-employed service providers instead of extending employment contracts. Given that employment protection becomes more severe once ventures reach specific employee thresholds, and given that the consequences of hiring under-performing employees are more severe for small ventures than for large firms (Davidsson and Henrekson 2002), it can be expected that the preference of hiring service providers rather than employees is particularly acute in new ventures.

The above reasoning leads us to expect that

Proposition 3: *national labour market institutions influence (a) the approach of founders towards committing themselves to venture creation, (b) the approach of founders towards hiring employees and (c) engaging service providers during venture creation.*

Also, the *nature of the good (product or service)* developed has been found to influence the number and type of gestation activities carried out – and thus the participation of founders and employees – during venture creation (Gordon and Davidsson 2013). On the one hand, ventures developing products require more resources than service developers (Ruef 2005); on the other, they are also more likely to pursue growth strategies due to their stronger need to achieve economies of scale (Audretsch et al. 2004). Consequently, a study of the Dutch hospitality sector finds that the growth patterns of small service ventures differ from those of small manufacturing ventures (Audretsch et al. 2004).

With regard to the involvement of founders in venture creation, Petrova (2012) explains how the more limited need for resources and slow growth trajectories lead to significantly higher shares of part-time entrepreneurs running business service rather than manufacturing ventures. These findings are supported by Germany's self-employment statistics in 2008, where the share of part-time entrepreneurs amounted to 15% in manufacturing and 36.2% in service ventures (Buddensiek et al. 2013).

With regard to the hiring of employees, Fritsch and Weyh (2006) illustrate that, on average, German manufacturing ventures do not only start out with more employees than their service providing counterparts; they also follow different growth trajectories during their first years of existence, so that the number of employees increases more substantially in product manufacturing than in service providing ventures.

The above reasoning leads us to expect that

Proposition 4: *the nature of a good a venture intends to sell influences (a) the approach of founders towards committing themselves to venture creation, (b) the approach of founders towards hiring employees and (c) engaging service providers during the venture creation.*

Finally, the *innovativeness of a venture's business idea* is also likely to influence the team formation approaches chosen. The innovation literature highlights that those ventures which develop new

business ideas, rather than imitating existing ones, can either be radically or incrementally innovative. While incremental innovators improve existing (technologies of) business ideas, radical innovators develop entirely new ones (Abernathy and Clark 1985). Depending on the type of innovation a venture develops, it faces different challenges (Amason et al. 2006; Samuelsson and Davidsson 2009). Ventures developing radical innovations mostly require tacit knowledge (Mascitelli 2000), because *"most knowledge is created and stored within individuals"* (Grant 1997). Therefore, the configuration of ventures' internal labor resources, that is founders and employees, is especially relevant for innovative ventures (Andries and Czarnitzki 2014).

With regard to founder involvement, this implies that founders need to carry out more and a broader range of gestation activities (Amason et al. 2006; Samuelsson and Davidsson 2009) in order to master the higher levels of uncertainty and complexity related to radical innovations (Liao and Welsch 2008; Samuelsson and Davidsson 2009). Consequently, ventures developing radically innovative business ideas are more likely to be created by large founder teams, because they tend to have more, and more diverse, resources at their disposal (Eisenhardt et al. 1990; Wiersema and Bantel 1992).

In line with this reasoning, ventures developing radical innovations also hire employees earlier and more substantially (Freel and Robson 2004). Given that the building up of tacit knowledge is both cost- and time-intense, it only pays off for ventures if employees are retained over longer time periods (Becker 1962; Virtanen et al. 2003). Consequently, radically innovative ventures can be expected to retain their employees for longer time periods than incrementally innovative ventures or imitators.

Accordingly, innovative ventures rely less on external service providers than imitative ventures, because the latter are more willing to accept limited tacit knowledge in return for the increased flexibility to increase, or decrease, their pool of external service providers (Chandler et al. 2009).

The above reasoning leads us to expect that:

Proposition 5: *the innovativeness of a venture's business idea influences (a) the approach of founders towards committing themselves to venture creation, (b) the approach of founders towards hiring employees and (c) engaging service providers during the venture creation.*

3. METHODOLOGY

3.1. The Data: Sample and Operationalization

To test the aforementioned propositions, we use a subset of the "Perfect Timing" (PT) database. Based on computer-assisted telephone interviews with founders, this dataset was collected between 2012 and 2016 by an international research team located in Utrecht (The Netherlands), New York (US), Germany (Düsseldorf and Cologne), London (UK), and Palermo (Italy). In order to capture possible variations in venture processes, the population chosen includes ventures of all legal forms (excluding sole proprietorship) that were registered between 2005 and 2011 in the information technology (IT) and alternative energy (AE) industries in Germany, and the US. Out of this population, founders were

randomly selected and invited to participate in an interview about the venture creation process of their company until a representative sample of 344 cases had been obtained.

The data's explicit focus on the timing and sequencing of venture creation activities enables us to study patterns in TFPs. Importantly, the dataset is restricted to the duration of the team formation process of each venture included. More concretely, this time span starts with the first time a founder, employee or service provider actively worked on venture creation and ends with the moment in which the venture in question generated sustainable profits (defined as 3 consecutive profitable months). If a new venture never made sustainable profits, three alternative TFP ends can occur, namely the acquisition, merger or liquidation of the respective venture. Had none of these events occurred, a TFP is categorized as ongoing until a maximum duration of 84 months. With regard to the team formation activities undertaken during the venture creation process, the dataset reports when each founder, employee, and external service provider started and, if applicable, stopped working for the new venture on a full-time or part-time basis.

To identify typologies of TFPs (dependent variable), we measure each venture's team formation activities by determining how many founders, employees, and service providers are involved at each month of the venture creation process. To this end, we first calculate the amount of time, expressed in full-time equivalents (FTE), invested in venture creation by each of the venture's founders. Second, we calculate the extent of employees hired (in FTEs) and, third, the number of service providers carrying out tasks for the new venture. For both the founder and employee dimension, we account for full-time as well as part-time arrangements (recorded as 0.5 FTE involvement). Our dataset thus records the extent of founder and employee involvement in increments of 0.5 from 0 to 5 FTE. For service providers, we record the number of service providers, because part-time arrangements are difficult to measure for external labour.

Table 1 Example of Team Formation Process

Dimension (in FTE)	Month										
	1	2	3	4	5	6	7	8	9	10	11
Founder	0.5	0.5	2	2	2	2	4	4	4	4	4
Employee	0	0	0	0.5	0.5	1.5	1.5	1.5	1.5	1.5	1.5
Service Provider	1	1	0	0	0	0	0	1	2	2	2

Given that venture creation processes were recorded on a monthly basis, we considered only the first five founders, employees, and service providers contributing to venture creation, so that 5.0 FTE also captures labour involvement of more than 5.0 FTE. As such, the dimensions reporting founder and employee involvement each have 11 states (ranging from 0 FTE to 5.0 FTE), while they have 6 states for contributions of service providers (ranging from 0 to 5 service providers). Table 1 provides an

example of how these team formation activities are reported for a venture that achieved profitability after 11 months.

We report the team formation activities for each of the 344 ventures included in our database. Table 2 provides some descriptive statistics of the TFPs of all ventures analysed, whereby the average TFP in the sample has a duration of 32.6 months. As Table 2 shows, TFPs are often small as the most common state for both the employee (67.1%) and service provider (46.1%) dimension is the involvement of 0 team members. For the founder dimension, the involvement of one founder at 1 FTE (33.4%) is the most frequent state. The average founder involvement throughout the TFP is 1.5 FTE, in contrast to the much lower levels of employee involvement (.72 FTE) and service provider contribution (.95 SP).

Table 2 Distribution of TFP states by dimension

Number of Team Members (in FTE)	Founder	Employees	Service provider
0	1.7%	67.1%	46.1%
0.5	15.8%	4.0%	
1	33.4%	10.0%	26.7%
1.5	17.2%	2.9%	
2	12.3%	5.7%	17.2%
2.5	7.9%	.9%	
3	7.3%	3.1%	6.6%
3.5	1.5%	.6%	
4	2.1%	2.8%	3.1%
4.5	.1%	.1%	
5	.6%	2.8%	.4%
Total	**100%**	**100%**	**100%**

We measure the different contextual factors (independent variables) that may influence which TFP is pursued by a new venture as follows. In order to measure the impact of labour market rigidity or, respectively, flexibility, we follow the standard approach of the Varieties-of-Capitalism literature which takes a country as a pars pro toto for its institutional environment (Hall and Soskice 2001b). In doing so, Germany is considered to be the most typical example of regulated labour-market institutions (Estévez-Abe and Iversen 2001), while the United States are considered to be the most typical example of labour market flexibility. Accordingly, we measure the flexibility of labour-market institutions by the country in which a venture is located, coding Germany as ‘0’ (limited labour-market flexibility) and the US as ‘1’ (indicating flexible labour-market institutions).

The innovativeness of a venture’s business idea was determined in a three-step process. In the first step, the founder was asked whether his business develops a radically new, incrementally new, or

imitative product or service.[1] In a second step, the interviewer (upon completion of the interview) cross-checked the founder's answer by comparing the venture's innovativeness with the innovativeness of the other ventures about which s/he had conducted interviews. In a third step, the person cleaning the data, again, cross-checked the degree of innovativeness indicated against the classification scheme he had developed while cleaning the data. In both step two and step three, the interviewer and the data cleaner relied on the information provided by the founder as well as on online information about the venture's business idea. This three-step process made it possible to minimize the over-estimation bias that typically occurs when founders self-report the level of their business' innovativeness. The degree of innovativeness was measured as imitation (0), improvement (1), or radical innovation (2).

The same three-step process was used to determine whether the new venture develops a product, a service, or a business idea that combines elements of product and service. Given that the number of ventures that only develop products is fairly limited (22.4%) , we code the nature of good developed as a dichotomous variable, distinguishing between pure service ventures (0) and those ventures that either offer products or services and products (1).

Furthermore, the following control variables are included: Possible industry differences in TFPs are controlled for by assessing whether the venture is active in the ICT industry (0) or the alternative energy industry (1). Furthermore, we assess whether a venture started independently (0) or as a spin-off (1), and whether a venture was registered in a year of well-being (0) or economic crisis (1).

Table 3 Descriptive Statistics of Independent and Control Variables

					Correlation Coefficient				
		N	Mean	Std. Dev.	1	2	3	4	5
	Control variables								
1	Industry [a]	344	.29	.453					
2	Spin-off [a]	344	.09	.291	-.071				
3	Crisis [a]	344	.41	.493	-.034	-.023			
	Independent variables								
4	Labour Market [a]	344	.4	.491	-.131**	-.121**	.036		
5	Innovativeness [b]	344	.64	.646	-.211***	.089*	-.063	.038	
6	Nature of Good [a]	344	.49	.501	.078	.064	-.114**	-.245***	.239***

a Pearson's r. *b* Spearman's rho. *p*-values *** < .01, ** < .05, * < .1.

Table 3 provides some descriptive statistics about the independent variables used in the below logistic regression analyses. Furthermore, we tested for multicollinearity, finding that not a single variance inflation factor exceeded the traditionally accepted value of 1.2 points, so that multicollinearity does not appear to be a problem.

[1] Concrete question asked in the questionnaire: 'How would you describe the degree of novelty of your venture`s core business idea?'

3.2. Analyses

In line with our theoretical illustrations, we run three different types of analyses: **(1)** In a first step, we assess whether a limited number of systematically different TFPs approaches exist to founder involvement, employee hiring, and service provider engagement (*Propositions 1a – 1c*) and illustrate how they look like. To this end, we use optimal matching (OM) techniques combined with cluster analyses, whereby each of the three TFP channels (founder, employee, and service provider involvement) constitute the respective units of analysis. The OM algorithm measures the distance between processes. If subsequently paired with cluster analyses, such sequence analyses allow us to explore and interpret patterns in longitudinal data (Halpin 2010).

Thus far, OM has mostly been used in sociology to explore career patterns (Abbott and Hrycak 1990; Biemann et al. 2012; Blair-loy 1999; Pollock 2007; Stovel and Bearman 1996). Only recently, Gordon (2012) applied OM techniques to explore gestation activities in venture creation processes. Given that more wide-ranging developments and applications of OM algorithms only occurred after the year 2000, OM can still be considered a fairly young method. Nevertheless, a standard way of running sequence analyses, based on OM techniques, has crystallized, which we here follow (Biemann and Datta 2014). It includes four steps:

Step 1: Coding the Data

The first step consists in reporting the team formation process of each venture on a monthly basis. More concretely, this means that a sequence of states needs to be created for each of the three dimensions (founder, employee, service provider involvement) of the TFP of each venture. As outlined above, this process can vary in length for each venture, because it reports the (founder, employee, service provider) state for each month of the venture's TFP – in FTE for founder and employee involvement and in absolute numbers for service providers (see Table 1).

Step 2: Define the Substitution Costs

In order to measure the distance between two TFP sequences, created in Step 1, a cost needs to be assigned for replacing one state by any other state with the aim of transforming one sequence into the other. These so-called substitution costs range from 0 to an arbitrary maximum (here: 2) and are often estimated on the basis of the frequency of transitions between two states within the entire dataset. In our case, the sequence states represent equally-sized steps along a continuous scales. This allow us to calculate the substitution costs as a linear interpolation between the minimum substation cost for equal states (0) and the maximum substitution cost (2) for the most distant states, as given by the number of FTEs difference between the two states.

To provide an example: replacing the minimal employee involvement of 0 FTE with the maximum of 5.0 FTE would have a cost of 2. Reducing the distance between two states by 0.5 FTE decreases the costs of exchanging these states by 0.2. Subsequently would the costs of replacing 0 FTE with 4.5 FTE be 1.8, 0 FTE with 2.5 FTE be 1 and so forth.

Step 3: Calculating Sequence Similarity

Based on these substitution costs, we then calculate (for each of the 344 sequences in our dataset) how costly it is to transform one sequence into any of the other 343 sequences. We do this for the founder, employee, and service provider dimension separately. The cost of transforming one sequence into the other expresses their respective distance. To calculate the distance of sequences that differ in length, we calculate their distance based on the length of the shorter of the two sequences. This reflects that the shorter of the two TFPs is unknown beyond the period observed and should thus not influence the difference measure. This novel solution addresses an often voiced concern of using OM for analysing sequences in social science that vary greatly in length (Aisenbrey and Fasang 2010).

Furthermore, we normalize the respective values of sequence difference by dividing them by the length of the shorter of the two sequences in order to maintain a comparable difference measure across sequence pairs. This results in three matrices (one for founder, employee, and service provider involvement respectively) which report the distances between each sequence pair.

To provide an example, consider two team formation processes, where the hiring of employees evolves as a four-month process, namely (in FTE) 1-1-2-2, in the first venture and as a three-month process 1-3-3 in the second venture. When we calculate their difference, we restrict the calculation to the number of months observed in the shorter of the sequences, in this case the first three months. Given that the states of the first period are identical, namely 1 FTE employee, their distance is zero. The states of the respective second period are 2 FTE apart, resulting in a transformation cost of 0.8 to equate the states (as reminder to the reader, the transformation costs are 0.2 for every 0.5 FTE, in this case 4*0.2 = 0.8). Given that the difference in the third period is only 1 FTE, the costs of equating these states is 0.4. In total, this amounts to transformation costs of 0 + 0.8 + 0.4 = 1.2 points. If we then normalize these costs via the length of the shorter of the two compared sequences; 1.2 / 3 = 0.4, we obtain the normalized costs of turning one sequence into the other, hence the distance of this pair of sequences.

Step 4: Perform a Cluster Analysis

In the concluding step, we cluster the founder, employee, and service provider dimensions of TFPs on the basis of their respective similarities. Consequently, all clusters obtained for each dimension encompass those processes that are particularly similar to each other, and distant to the processes of other clusters. Consequently, each cluster represents a distinct approach to founder, employee, or service provider involvement during TFPs.

(1) We use a combination of various partition quality measurements, namely the Weighted Average Silhouette Width (ASWw), R^2, Point Biserial Correlation (PBC) and Hubert's C (HC) to determine the optimal clustering solution amongst solutions which contain between one and twenty clusters. These measures indicate how similar sequences are within one cluster and how different they are between

clusters. Consequently, we calculated these indicators for one, two, three, etc. , up to twenty clusters in order to determine their goodness of fit. In this way, we could determine for which cluster number the goodness of fit was maximized. In doing so, we also excluded cluster solutions which either did not yield distinct approaches because they clustered together too different sequences or spread out sequences over too many similar clusters.

(2) In the second step, we run correlation analyses in order to understand whether there are systematic relationships between the extents to which founders, internal labour (employees) and external labour (service providers) are involved in venture creation (*Propositions 2a – 2c*). We do so based on the likelihood of a venture ending up in a particular cluster pair across two channels. Since the expected cell count in the contingency tables is low (< 5) for a large number of cluster-combinations (56% of the cells), we use Fisher's exact test to examine the statistical significance of our results.

(3) In the third step, we use one-versus-rest logistic regression models to identify the conditions that influence the team formation approaches taken towards founder, employee, and service provider involvement (dependent variable) during the TFP. Testing *Propositions 3a – 5c*, we determine the explanatory power of labour market flexibility, the innovativeness, as well as the nature of the good developed by the new venture (independent variables), whereby we control for the venture's industry, year of registration, status as an independent or spin-off venture (control variables).

We fit the following model for each cluster to obtain the estimates:

$$ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 LabourMarket_i + \beta_2 Innovativeness_i + \beta_3 NatureOfGoods_i + \boldsymbol{\beta'} \boldsymbol{x}_i \quad (1)$$

where p_i denotes the probability that venture i belongs to the cluster rather than to any of the other clusters, β_0 the cluster's intercept, β_1, β_2, and β_3 the estimated coefficients for our independent variables, $\boldsymbol{\beta}$ a vector of coefficients for the control variables, and $\boldsymbol{x}_i$ a vector of control variables.

4. RESULTS

4.1 Patterns in Team Formation Processes

The partition quality measurements identify the solution of 7 clusters (out of the overall 1-20 solutions considered) as optimal for different approaches of founder involvement in venture creation (ASWw = 0.46; R^2 = 0.68; PBC = 0.44; HC = 0.06). Given that any of these 7 clusters reveals a distinct approach to founder commitment to venture creation, we find support for *Proposition 1a*.

The 7 clusters we identify are fairly homogenous in size with two exceptions: The second founder cluster (F2) is the largest cluster, including 108 ventures. In turn, cluster F7 (Large founder team) is smallest (n = 13), while the remaining clusters contain between 37 and 54 ventures.

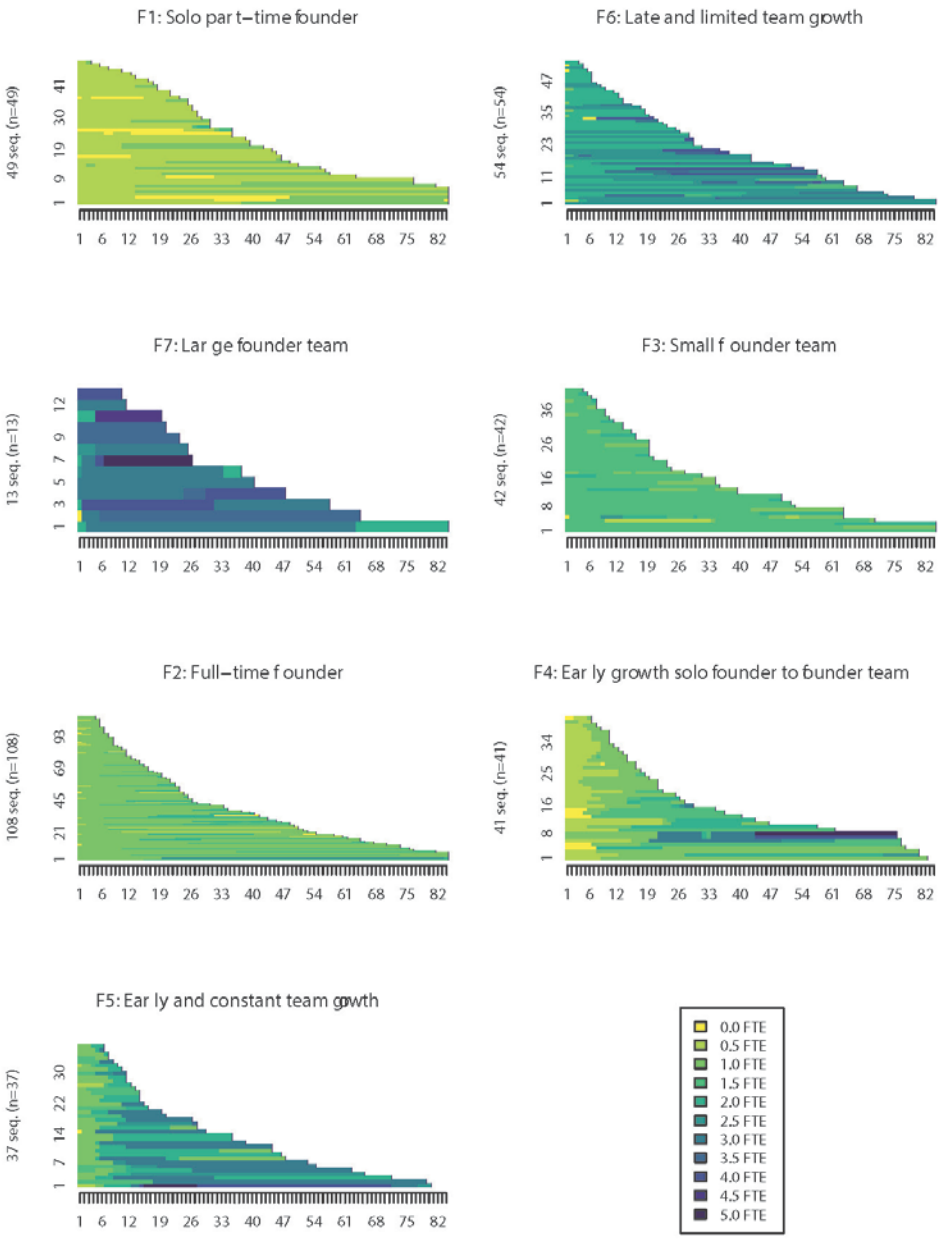
F1 is the third largest cluster (n = 49) and features ventures with a single part-time founder. Hence, for most of the TFP, founder involvement is 0.5 FTE in this cluster. While a minority of ventures goes through intermittent periods of inactivity or an increase to 1 founder FTE, this is a largely static approach. F2 (Full-time founder) and F3 (Small founder team) exhibit similarly static processes in which the founders invested 1 FTE, respectively 1.5 FTE for much of the process, with a few

exceptions scaling up or down towards the end of the process. Ventures grouped together in F7 (Large founder team) don't display a clear transition pattern either, but start out with larger founder team (3 FTE) than those in any other cluster.

The three other approaches taken to founder involvement are more dynamic. Accordingly cluster F6 (Late and limited team growth) , consists of ventures that start out with a mid-sized team of 2 or 2.5 FTE. Most ventures, especially those with longer TFPs, subsequently increase the founder involvement to up to 4 FTE. The sequences is F4 (Early growth solo founder to founder team) and F5 (Early and constant team growth), are characterized by clear transition patterns. Accordingly, ventures in F4 begin the process with a founder involvement of 0.5 FTE and subsequently scale up to 1 or more founders around 9 months. Their counterparts in F5 begin at 1 FTE, before choosing to increase founder commitment after about 7 months, eventually settling on 2 to 3 FTE of founder involvement.

With regard to the clustering of the approaches taken towards employee hiring, the partition quality measurements indicate that a 6 cluster solution (out of the 1-20 cluster solutions considered) is best (ASWw = 0.64; R^2 = 0.63; PBC = 0.55; HC = 0.06). Given that each of these 6 clusters represents a distinct approach towards employee hiring throughout the venture creation process, we find empirical support for *Proposition 1b*.

Figure 1: Distinct approaches to founder involvement



The distribution over the 6 approaches found for employee hiring is heavily skewed and less homogenous than that of the founder dimension. By far the largest group of ventures (n = 226) is found in employee cluster E1, a cluster characterized by the absence of employees. Compared to this passive and static approach to hiring employees, the rest of the clusters are more dynamic and are characterized by transition patterns and different levels of employee hiring. They range from 5 to 52 ventures in size.

E3 (Early and limited hiring) and E5 (Early and extensive hiring) both depict an approach in which the venture begins without an employee but then starts hiring within the first 6 months of the TFP. The major difference between these two approaches consists in the extent of hiring. Whereas ventures following the 'Early and extensive hiring' approach (E5) hire up to 5 FTE, their counterparts following the 'Early and limited hiring' approach (E3) transition from no employee to 1 or 2 FTE after 6 months. Similarly dynamic transitions can be observed in E4 and E2. While the transition from no to 2-3 FTE in the 'Late and extensive hiring' approach (E4) happens after about 9 months, ventures following the 'Late and limited hiring' approach (E2) hire to a lesser extent (around 1 FTE) and do so mostly 12 months into the TFP or even later.

Furthermore, E2 and E3 both depict an approach in which ventures begin without an employee but eventually hire employees to the capacity of 1 FTE. The difference between these two approaches is the timing of the transition. In ventures pursuing the 'Early and limited hiring' approach (E3), this transition takes place within the first 6 months, while this typically takes more than 12 months for ventures following the 'Late and limited hiring' approach (E2). We observe a much stronger and more immediate employee involvement amongst ventures following the 'Immediate and extensive hiring' approach (E6). While only few ventures (n = 5) fall in this cluster, it is the most expansive approach as ventures start with 1-2 FTE employees and quickly expand to up to 5 FTE employees.

Regarding possible approaches taken towards engaging service providers, the partition quality measurements identify the 5 cluster solution (out of the overall 1-20 solutions considered) as optimal (ASWw = 0.43; R^2= 0.48; PBC = 0.57: HC = 0.08). Given that these results indicate that five distinct approach towards engaging service providers exist, this lends empirical support for *Proposition 1c*.

Figure 2: Distinct approaches to employee hiring

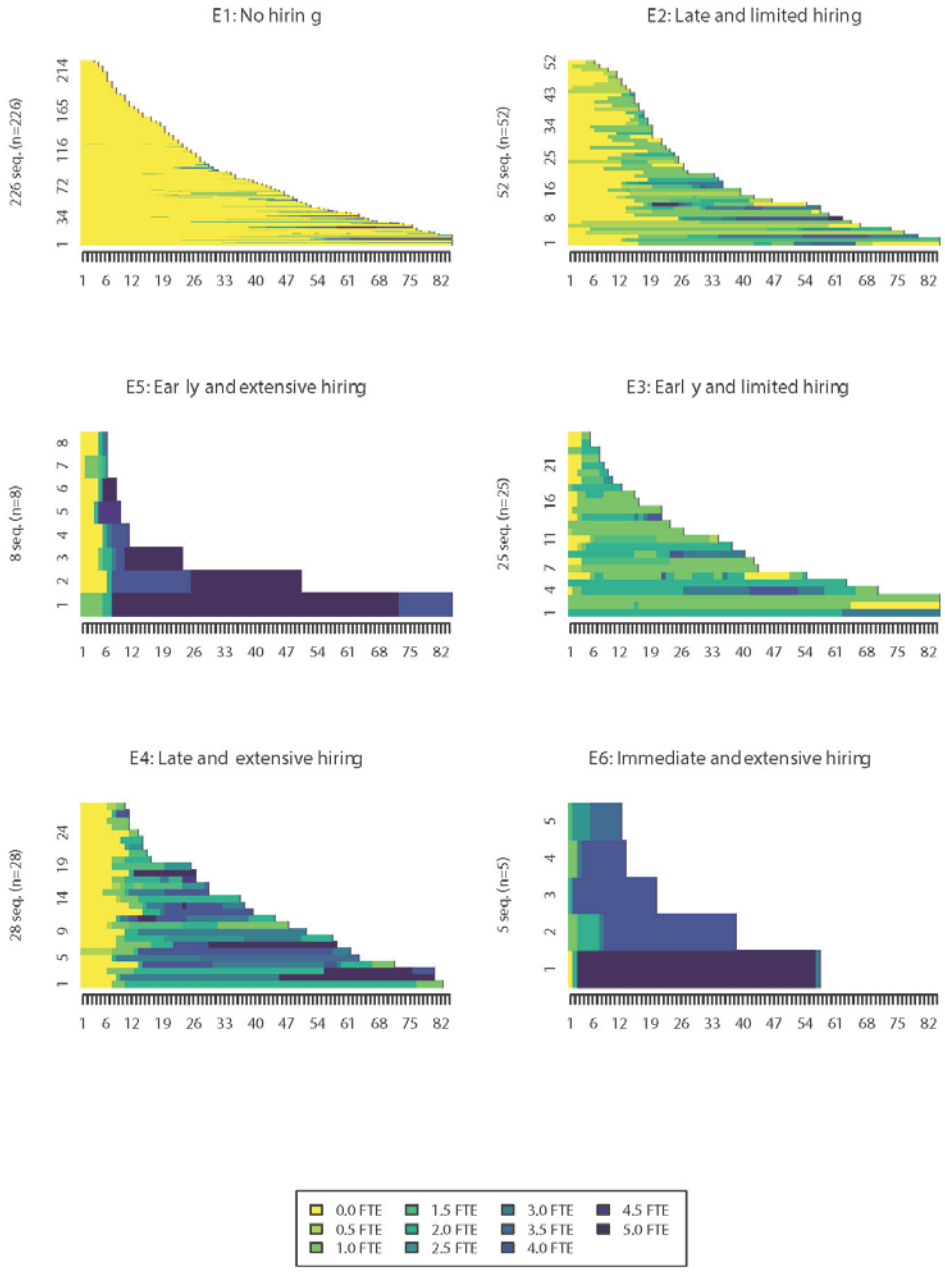
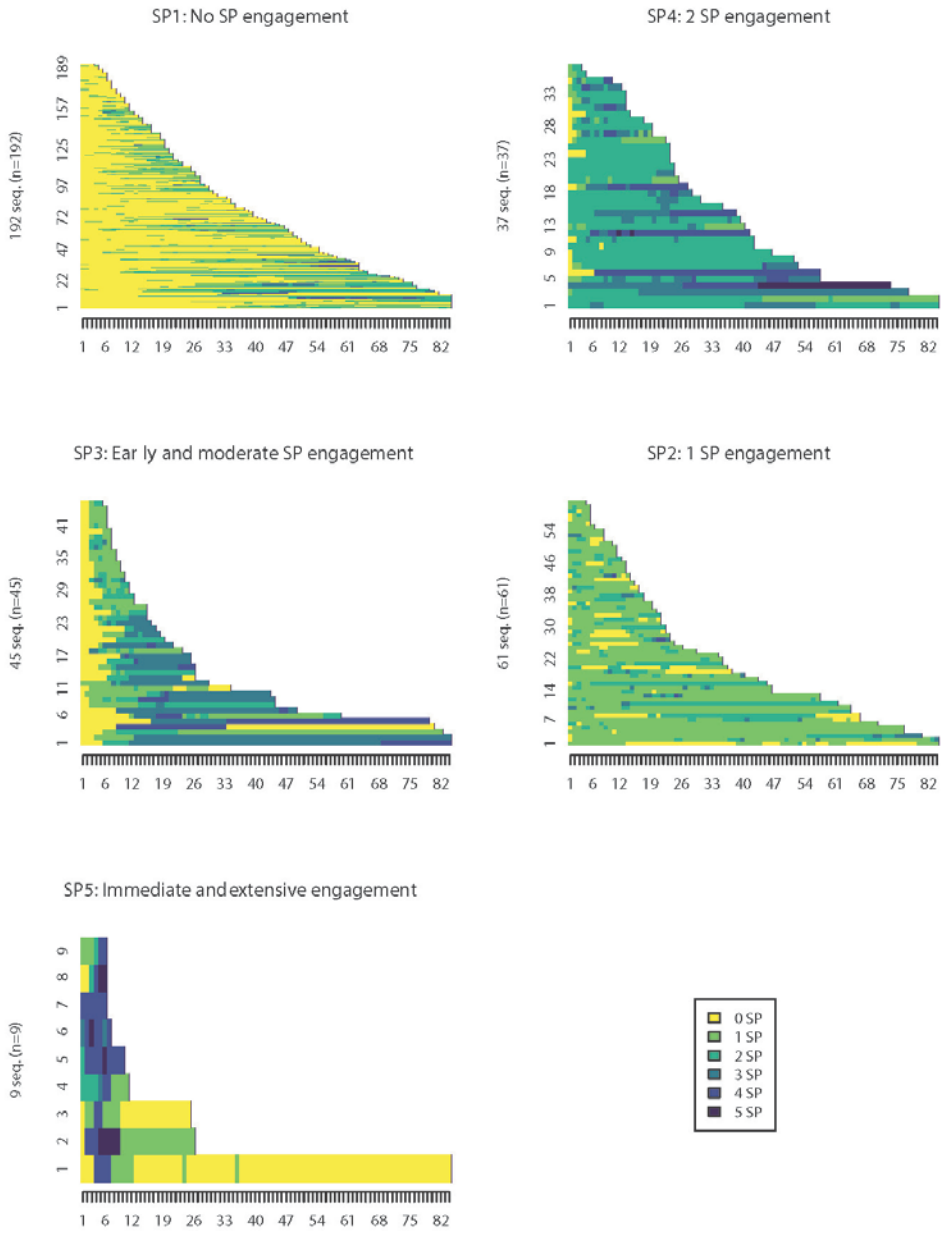


Figure 3: Distinct approaches to service provider engagement



The 5 clusters identified in the service provider dimension are similarly heterogeneous in size as those of the employee dimension. In parallel to the employee dimension, the largest cluster (SP1) is dominated by inactivity. With a size of 192 ventures it is more than 3 times as big as the second largest cluster SP2 (n = 61).

In contrast to SP1, SP2 (1 SP engagement) features ventures that typically involve 1 service provider. These ventures hire one service provider early on and sustain or repeat collaboration with this service provider for the remainder of TFP. Ventures in cluster SP4 (2 SP engagement) typically rely on 2 service providers. In most cases, these service providers were engaged immediately at the start of the TFP. While some ventures eventually hire more than 2 service providers, the cluster contains mostly static sequences In SP3 (Early and moderate SP engagement) we find ventures that rely similarly heavily on external service providers, but mostly started hiring them after about 6 months into the TFP. The last cluster, SP5 (Immediate and extensive SP engagement), is small, and is characterized by immediate and intense collaboration with external providers. However, this collaboration is very brief, either because the venture creation is quickly completed or because service providers are not retained for the remainder of the TFP.

4.2 Correlations between Founder, Employee, and Service Provider Involvement

In line with *Proposition 2b*, Fisher's exact test reveals that there is no significant correlation between the approaches taken towards founder and service provider involvement. Overall, we also find support for *Propositions 2a and 2c* as we find statistically significant correlations between the approaches towards founder and employee involvement on the one hand, and employee and service provider engagement on the other. However, the low Cramer's V values (.19 and .15 respectively) indicate that the observed correlations are comparatively weak. To better understand these correlations, we investigate the links between founder and employee involvement (table 5) and employee and service provider engagement (table 6) with the help of pair-wise cross-tabulations .

Table 4 Correlation between TFP dimension

Dimensions	Fisher's Exact Test	Cramer's V
Founder x Employee	50,684***	.194
Founder x Service Provider	27,125	.137
Employee x Service Provider	26,685*	.149

p-values *** < .01, ** < .05, * < .1.

The cross-tabulations of the cluster pairs of the founder and employee dimension demonstrate that the observed correlations stem from a limited number of cluster pairs that co-occur particularly often (Table 5). In line with *Proposition 2a*, these reveal additive effects between the involvement of founders and the hiring of employees. Accordingly, E1 including ventures which never hire an employee frequently co-occur with part-time entrepreneurship throughout the venture creation process

(F1). In contrast, ventures growing to larger founder teams over time (F5) are under-represented in said E1, indicating that founder teams committing substantial amounts of their own time are rare in ventures that abstain from hiring. The combination of F3 (Small founder team) and E2 (Late and limited hiring) co-occurs particularly often and is indicative of a slow growth process driven by a single full-time founder or a duo of two part-time founders. Another indication of additionality between founder involvement and employee hiring is that ventures in the two transition clusters F4 (Early growth solo founder to founder team) and F5 (Early and constant team growth) are associated with the transition cluster E4 (late and extensive hiring). We thus conclude that *Proposition 2a* is empirically supported.

With regard to employee hiring and service provider engagement, we find substitute effects (Table 6).

Table 5 Overlap between founder and employee clusters

Founder cluster	Employee cluster					
	E1	E2	E3	E4	E5	E6
F1	***79.6%***	18.4%	*	*	*	*
F2	65.7%	11.1%	13.9%	5.6%	*	*
F3	57.1%	***26.2%***	*	*	*	*
F4	68.3%	***9.8%***	*	***14.6%***	*	*
F5	***51.4%***	16.2%	*	***21.6%***	*	*
F6	70.4%	18.5%	*	*	*	*
F7	53.8%	*	*	*	*	*
Column total	**65.7%**	**15.1%**	**7.3%**	**8.1%**	**2.3%**	**1.5%**

***** = < 5 expected observations. Values indicate percentage of the row cluster that is in the column cluster.

Accordingly, 'Late and limited hiring' approaches (E2) hardly co-occur with not hiring any service providers (SP1), but are more likely to co-occur with 'Early and moderate SP engagment' (SP3). Ventures hiring multiple employees at a comparatively late stage (E4) tend to make early and continuous use of one external service provider (SP2).

Table 6 Overlap between employee and service provider clusters

Employee cluster	Service provider cluster				
	SP1	SP2	SP3	SP4	SP5
E1	60.6%	15.9%	9.7%	11.1%	2.7%
E2	***44.2%***	21.2%	***21.2%***	11.5%	*
E3	56%	*	*	*	*
E4	50%	***25%***	*	*	*
E5	*	*	*	*	*
E6	*	20%	*	*	*
Column total	**55.8%**	**17.7%**	**13.1%**	**10.8%**	**2.6%**

***** = < 5 expected observations. Values indicate percentage of the row cluster that is in the column cluster.

While the majority of combinations between employee hiring and service provider engagement seem to be independent of each other, we see that employee hiring and service provider engagement is substitute in those instances where they co-occur. This, in turn, lends empirical support to *Proposition 2c*.

4.3 Determinants of Approaches towards Founder, Employee, and Service Provider Involvement

Having found systematically different approaches to founder, employee, and service provider involvement in team formation, what are the drivers of each approach? In other words, under which conditions do founders contribute to venture creation in one rather than another way? While most of the founder approaches (namely clusters F6, F3, F2, and F4) do not differ as a function of the structural factors mentioned in the literature,[2] part-time entrepreneurship (F1) is more likely in product developing ventures, while it is less likely if ventures develop a radically and incrementally innovative business idea. Finding an association between ventures developing products and part-time entrepreneurship (F1; Exp $\beta = 1.895$; $p < .1$) might be surprising at first glance and contradicts the reasoning underlying *Proposition 4a*. Yet, when looking at the cases in founder cluster F1, part-time entrepreneurship can be explained by a high number of software engineers working on simple software products (apps), as well as farmers running alternative energy ventures in part-time next to their main business. Contrary to that, it is not surprising that innovative ventures are less often run by one part-time entrepreneur. As suggested by *Proposition 5a*, imitative ventures do not require a high time commitment from their founders. The low coefficients for both degrees of innovativeness (0.341, respectively 0.293) associated with F1 clearly indicate the absence of innovative ventures amongst single part-time entrepreneurs.

[2] Given that the R^2s of these four clusters are low, factors other than the external ones included – such as process-related measures (e.g. whether, or not, the venture acquired external finance) – may be more relevant explanators. Yet, in answer to the claims of (Gartner and Shaver 2012; Samuelsson and Davidsson 2009) to study the impact of contextual factors on venture creation, we here focus on the aforementioned models.

Table 7 Regression estimates for founder clusters[1)]

	Founder cluster (Exp β)					
Variable	F1	F2	F3	F4	F5	F6
Nature of Good	1.895*	.695	.91	.824	1.286	.914
Innovativeness Incremental	.341**	.964	.961	.984	3.014**	1.314
Innovativeness Radical	.293**	1.75	.736	1.5	1.447	1.199
Labour Market	1.518	1.223	.775	1.197	.352**	.996
Industry	.594	1.449	.95	1.579	.402*	1.393
Spin-off	.985	.931	1.003	1.175	1.117	.757
Crisis	1.441	.75	1.084	.894	.922	1.316
Intercept	.165***	.487***	.165***	.118***	.094***	.139***
Observations in Cluster	49	108	42	41	37	54
Total Observations	344	344	344	344	344	344
R^2	.073	.031	.005	.015	.128	.012

p-values *** < .01, ** < .05, * < .1.

1) Cluster F7 not included, because number of cases too limited for meaningful regression results

The only other founder approach that is significantly associated with several structural factors is the transition process from 1 FTE to 2 or more FTE (F5). Founders pursuing this approach are much more likely to work for incrementally innovative, but not for radically innovative ventures (F5; Exp β = 3.014; p < .1), lending only partial support to *Proposition 5a*. Yet, in line with our reasoning of *Proposition 3a*, founders transitioning from low to higher time commitments are roughly three times more likely to be found in regulated rather than deregulated labour markets (F5; Exp β = .352; p < .05). Finally, founders in cluster F5 (early and constant team growth) are also more likely to be active in ICT rather than alternative energy industries.

With regard to the drivers of the approach chosen towards employee hiring, it is first interesting, and rather unsurprising, to note that the hiring of no employees (E1) occurs less frequently in incrementally innovative ventures (E1; Exp β = .646, p < .1). This, in turn, lends support to the reasoning of *Proposition 5b*. Also spin-offs are markedly less likely *not* to hire any employees (E1; Exp β = .386; p < .05), but twice as likely to hire at least one employee about twelve months after the start of venture creation (E2; Exp β = 2.14; p < .1). Furthermore, alternative energy ventures are significantly more likely to hire at least one employee twelve months after venture begin (E2; Exp β = 2.517; p < .05). This might be explained by the long time it takes to obtain all required permits, which implies that employees in alternative energy ventures are hired relatively late in the TFP.

As suggested by the reasoning underlying *Proposition 4b*, ventures developing products require more resources and need longer time to assemble these resources. The finding that product developers tend to hire rather 'late and extensive' (E4) thus supports *Proposition 4b* (E4; Exp β = 2.222; p < .1).

Finally, we do not find any evidence in support of the idea, expressed in the reasoning of *Proposition 3b*, that regulated labour-market institutions hamper the hiring of employees.

Table 8 Regression estimates for employee clusters[1)]

	Employee cluster (Exp β)			
Variable	E1	E2	E3	E4
Nature of Good	.881	.963	.482	2.222*
Innovativeness Incremental	.646*	1.506	1.107	1.371
Innovativeness Radical	1.160	.443	1.772	1.059
Labour Market	1.255	.698	1.156	.948
Industry	.698	2.517**	1.245	.520
Spin-off	.386**	2.14*	.412	1.428
Crisis	1.318	1.177	.394*	.854
Intercept	2.486***	.111***	.122***	.057***
Observations in Cluster	226	52	25	28
Total Observations	344	344	344	344
R^2	.063	.075	.057	.052

p-values *** < .01, ** < .05, * < .1.

1) Clusters E5 and E6 not included, because number of cases too limited for meaningful

Regarding the engagement of service providers we observe several significant conditions in which ventures are particularly likely not to engage any service providers (SP1). We find twice as many German as American ventures not to hire service providers (SP1; Exp β = 2.081; p < .05). As outlined in, and in support of, the theoretical illustrations leading to *Proposition 3c*, rigid labour-market institutions are thus likely to stimulate the use of external service providers. Furthermore, we find that product developing ventures are more likely not to hire service providers (SP1; Exp β = 1.617; p < .05). Given the literature's argument that product developers invest and scale up more than service developers, this finding – together with the above finding on employee hiring – can be interpreted to the extent that product developing ventures prefer the stability of hiring employees over the flexibility of engaging service providers. This supports *Proposition 4c* that the nature of the produced influences the approach to engaging service providers.

Interestingly, we observe the opposite associations with cluster SP3 (Early and moderate SP engagement), which means that ventures in rigid labour markets (SP3; Exp β = .532; p < .1) as well as ventures developing services (SP3; Exp β = .495; p < .05) are twice as likely as their respective counterparts to substantially hire service providers about 6 months into the TFP. This lends additional support to the reasoning underlying *Proposition 3c* and *Proposition 4c*.

No support is found for the reasoning underlying *Proposition 5c*, which suggests that the innovativeness of a venture's business influences the extent of service provider engagement. However,

we find evidence that ICT ventures are likely to not hire any service providers (SP1; Exp β = .553; p < .05), but highly unlikely to intensely engage service provider (SP4; Exp β = 2.964; p < .05). We therefore conclude that, depending on their industry, ventures take significantly different approaches towards hiring service providers.

Table 9 Regression estimates for service provider clusters[1)]

	Service provider cluster (Exp β)			
Variable	SP1	SP2	SP3	SP4
Nature of Good	1.617**	.892	.495**	1.166
Innovativeness Incremental	.823	1.113	1.312	1.134
Innovativeness Radical	.653	1.531	1.401	.952
Labour Market	2.081**	.662	.532*	.714
Industry	.553**	1.343	1.039	2.964**
Spin-off	.952	.795	1.133	1.300
Crisis	1.375	.860	.659	.940
Intercept	.893	.24***	.255***	.078***
Observations in Cluster	192	61	45	37
Total Observations	344	344	344	344
R^2	.073	.018	.04	.064

p-values *** < .01, ** < .05, * < .1.

1) Cluster SP5 not included, because number of cases too limited for meaningful regression results

5. DISCUSSION AND CONCLUSIONS

What have we learned about possible approaches to team formation during venture creation and their drivers? Most importantly, our analyses lend support to the underlying assumption of both the stage-based (Levie and Lichtenstein 2010) and the activity-based literatures (Gartner and Shaver 2012; Liao et al. 2005) that team formation processes are 'order, not chaos'. Yet, in contrast to the stage-based literature, we did not find one best way of organizing team formation during venture creation. Instead, we identified seven distinct ways in which founders contribute to venture creation (ranging from part-time entrepreneurship to strongly growing founder teams), six different approaches towards hiring employees (ranging from no hiring to the immediate hiring of numerous employees), and five distinct ways of engaging service providers (also ranging from the engagement of no service providers to a high number thereof). Most importantly, these approaches differ from each other in the extent to which they are static or, respectively, dynamic: Whilst static approaches are characterized by a stable number of founders, employees, or service providers contributing to venture creation, their number varies throughout the venture creation process in dynamic clusters – whereby it is interesting to note that, with one exception, all dynamic approaches are characterized by an increase, rather than a decrease, in team size.

Interestingly, the approaches taken towards founder, employee, and service provider involvement during venture creation, partly correlate with each other. In other words, the extent to which founders

engage in venture creation on the one hand, and hire employees and service providers on the other, is partly correlated. With regard to founder and employee involvement, we observed additionality effects as previously described in the literature (Cooper et al. 1989; Reynolds and White 1997), meaning that founders who only engage part-time in venture creation often also abstain from hiring any employees. Similarly, ventures whose founder team grow slowly over the venture creation process also slowly increase their employee base by about 1 employee over time. The same holds for high-growth ventures that are characterized by both substantially growing founder and employee teams. Interestingly, such additionality effects could only be observed for internal labour resources, i.e. between founder and employee involvement. Systematic correlations between founder and service provider approaches could not be observed. Finally, and in line with (Román et al. 2011), we found some substitution effects in the extents to which employees and service providers are engaged in venture creation as ventures tend to rely on service providers in those moments where hardly any employees are hired, and vice-versa.

Finally, we showed that several structural conditions influence which approach is taken towards founder involvement, employee hiring and service provider engagement. Accordingly, we saw that the nature of the good developed (product or service) often influences team formation approaches, while labour-market institutions and the innovativeness of a venture's business idea partly impacts on team formation processes: Contrary to service developers, product developing ventures are characterized by part-time founders, the late but intense hiring of employees, and the early and intense hiring of service providers (see Audretsch et al. (2004), Fritsch and Weyh (2006)). Furthermore, the team formation processes of incrementally innovative ventures are hardly characterized by part-time founders but rather by slowly increasing founder teams and the systematic hiring of employees. Finally, rigid labour-market institutions imply that ventures grow their founder team rather slowly, do not impact the approach taken towards employees hiring, but make that ventures substantially rely on external service providers to get the work done. Overall, and in line with the VoC literature (see (Hall and Soskice (2001b)), our results thus suggest that institutional labour-market rigidity leads to small-scale growth.

Furthermore, our paper also offers important methodological contributions. By applying optimal matching techniques to analyze venture creation processes, we illustrate how this novel methodological approach can be used in business and management research. Our research thus offers a methodological answer to the long-standing call for systematic insights into how venture creation processes unfold over time (Moroz and Hindle 2012; Ruef 2005; Van de Ven and Engleman 2004). In addition, we developed a new way to determine the distances between sequences of highly different lengths, a problem that is frequently occurring in social processes (Aisenbrey and Fasang 2010). We hope that our methodological advancements can contribute to, a much needed, better understanding of longitudinal data in the context of venture creation.

Like virtually all research, our study has its limitations, which pave the way for future research. To better assess the impact of different labour-market institutions, a broader database including data for more than two countries would be highly useful. Besides broadening the existing database, future research should also focus on other drivers of team formation than the ones we considered. This is particularly true as the low R^2-values of our regression analyses indicate that other factors than the ones included exist that have a significant influence on a venture's team formation approach. These factors might also include internal and time-dependent characteristics of ventures, such as the funding acquisition process of a venture. Finally, future studies would also provide novel and highly appreciated insights if they could link team formation processes to specific outcomes, such as venture success.

With our exploration of team formation processes, we have investigated a part of venture creation that has mostly been a black box in the past. While previous research has chiefly studied the link between venture characteristics and the outcomes of venture creation, namely growth and success, we here provide a detailed account of how team formation plays out between the starting and end point of venture creation. By uncovering that distinct team formation processes exist, and what they look like, we have been able to discern differences in venture creation that have, to date, been largely ignored.

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32 Abstract

The political economy literature on “Varieties-of-Capitalism” demonstrates that, and how, the composition of a firm’s human resources is shaped by national labor-market institutions. As these institutions drive firms to pursue human-resource strategies, in line with the comparative advantages offered, systematic differences exist between countries in the skill profiles of corporate workforces. Importantly, though, this causal link has only been established for incumbent firms, whereas the process of skill composition in start-up ventures remains understudied. While entrepreneurship research theorizing about the team formation in start-up ventures exists, such studies mostly focus on different outcomes of team formation, for example the number of employees. Questions about how team formation processes unfold and the factors, such as labor-market institutions, influencing their evolvement remain unanswered. To address this research gap, we analyze the venture creation processes of 344 ventures in Germany and the USA, offering particularly typical examples of countries with regulated and deregulated labor-market institutions respectively. Based on optimal matching techniques, we illustrate how team formation processes differ over time in terms of founder and employee involvement and the hiring of service providers. Furthermore, we use binary logistic regressions to identify the extent to which national labor-market institutions account for these differences.

33 Keywords separated by ' - '

New venture creation - Team formation - Entrepreneurship - Varieties-of-capitalism - Optimal matching - Labor-market institutions - L26 - M13 - M54

34 Foot note information

Follow the Money: The Funding Acquisition Process of Nascent Ventures

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Content

1. Executive summary

In view of the agency problems linked to the acquisition of funding by new ventures, the literature often assumes a ‘pecking order’ of finance acquisition: New ventures are expected to first access their founders’ resources, to then acquire funding from family and friends , and in a last step to acquire equity and debt from external (institutional) sources. Despite various studies on the capital structure of ventures, we still know little about how the funding acquisition process evolves at the firm level. This is particularly acute because the existing studies of capital structures often take a rather static view and use meta-level data to analyse a dynamic firm-level process. Based on novel optimal matching techniques, we identify the most typical funding acquisition processes of nascent ventures regarding the sequence of funding types (equity, debt, grant) and sources (founder, insider, external). Furthermore, we use binary logistic regressions to identify the determinants of funding acquisition processes. As a result we offer a more realistic picture of how funding acquisition processes evolve in nascent ventures.

2. Introduction

The public discussion about stimulating entrepreneurship and innovation, especially in Europe, is often dominated by perceived difficulties of nascent ventures to access funding (Bertoni et al., 2016; Nightingale et al., 2009). This problem has been aggravated through the increasing restrictiveness of banks after the financial crisis and corresponding regulatory measures (Block and Sandner, 2009; Cowling et al., 2016; Migendt et al., 2017). Especially sources of funding that allow for experimentation and innovation such as venture capital are less developed in Europe than for example in the US (Bertoni et al., 2015; Migendt et al., 2017; Polzin et al., 2018).

Most common theoretical explanations of this under-funding of innovative ventures and corresponding research are based on principal-agent theory (Block et al., 2018; Brancati, 2015; Cowling et al., 2016; Drover et al., 2017). The latter predicts that the separation between financiers and entrepreneurs/ventures will lead to information asymmetries and hence incomplete contracts. Failure by the financiers to judge the true quality of the venture may lead to (ex-ante) adverse selection or (ex-post) moral hazard situations.

Building on these mechanisms of the principle-agent theory, the entrepreneurial finance literature conceptually describes the funding acquisition process of ventures in the pecking order theory (POT) (Myers and Majluf, 1984). POT describes the effects of the principle-agent theory on each funding source and, as a result, depicts a preference order of funding sources and capital structure over the course of venture development and growth (Cumming, 2005a; Robb and Robinson, 2014; Sapienza et al., 2003; Sogorb-Mira, 2005). The stylized order starts with founder equity, followed by insider equity, for which information asymmetries and moral hazard concerns are typically low, so that costs are limited. Once these sources are exhausted, entrepreneurs are expected to turn to institutional debt-providers, such as banks. If debt acquisition fails, external equity is said to be acquired last, because the latter typically requires giving up control rights over the venture.

The literature struggles to empirically confirm the predominance of the depicted linear funding acquisition process (Cumming, 2005a; Frank and Goyal, 2003; Robb and Robinson, 2014). This struggle has been ascribed to two causes: first, a host of factors that have been identified which

mitigate the principle agent problems for some types of ventures and, second, a methodological one. Methodologically, the capital structure literature relies on metadata of venture funding to analyse a process that happens on the firm level (Cumming, 2005a; Frank and Goyal, 2003). These studies typically use balance sheet data and/or (panel) survey data, such as the PSED study, to link the type and amount of funding to outcomes of the venture creation process, such as venture success or size (Dimov, 2010; Hechavarría et al., 2016; Renko, 2013; Reynolds, 2011). While the sums invested per source and type inform us about the weight of each of these funding options in overall venture funding, they say little about the individual funding acquisition process of ventures (Hechavarría et al., 2016). This is particularly true as most studies rely on year by year data and, thus, a rather static measure for a process that can drastically change within weeks or months (Cassar, 2004; Gartner et al., 2012). Process-oriented evidence of the funding acquisition process of nascent ventures is limited (Audretsch et al., 2012; Cassar, 2004; Hechavarría et al., 2016). As a result, little is known about the sequence(s) in which ventures acquire specific amounts and types of funding (Gartner, 1985; Gartner et al., 2012; Gompers and Lerner, 1998; Polzin et al., 2018).

In this paper we disentangle how these processes look like in terms of sequence of funding option such as founders own funds, external equity and debt and which determinants influence them (Berger and Udell, 2006; Kim et al., 2006) and answer long standing calls in entrepreneurship research to explore processes with the help of large longitudinal datasets (Cassar, 2004; McMullen and Dimov, 2013; Ruef, 2005; Ucbasaran et al., 2001).

To this end, as (Cassar, 2004, p. 279) notes: *"The ideal sample (…)consists of entrepreneurs in the process of starting a venture and tracking these entrepreneurs through the initial stages of business formation"*. It takes an event, rather than an outcome driven research approach to thoroughly understand organizational developments that unfold over time, such as the funding acquisition process (Aldrich, 2001). Such an approach takes a process view and explores *"How [..] the entrepreneurship process unfold[s] over time?" rather than what it antecedents or consequences are* (Van de Ven and Engleman, 2004). Accordingly, we here ask:

Do nascent ventures pursue different approaches to funding acquisition and, if so, how do these processes look like and what are their determinants?

We contribute to the literature on the funding of nascent ventures by exploring the funding acquisition processes of early-stage ventures based on a unique and novel dataset of 755 nascent ventures in Europe (UK, Germany, Italy, Netherlands) and the US. This set-up permits us to identify transitions between different funding sources from venture inception until profitability, as well as to differentiate between different overall funding approaches. Importantly, our sample introduces the temporal component missing in previous studies. In addition, our data is explicitly not limited to highly innovative ventures but offers a representative sample of all ventures registered. Based on optimal matching techniques, we illustrate how funding acquisition processes differ over time in terms of equity, debt and grants. Furthermore, we use binary logistic regressions to identify the extent to which innovativeness, type of good or venture size account for these differences.

The results allow us to qualify pecking order theory: Accordingly, we show that, by far, the most common funding acquisition process is a static one that almost exclusively relies on equity provided by the venture's founders. Interestingly, this approach is frequently pursued by service providing ventures in the ICT industry. In addition, we observe a significant number of ventures that follow a transitory process from founder-equity based funding to debt-based funding. Ventures developing tangible products are especially likely to follow this approach. Furthermore, we find innovative ventures to combine grant acquisitions at an early stage with founder equity, or to start with external equity altogether. Contrary to the focus of an important part of the entrepreneurial finance literature, we show that external (venture capital) investors only provide funding to a very small number of ventures. In addition to these theoretical contributions, our research also seeks to pave the way for the use of sequence analysis as this method is, to date, largely unknown in entrepreneurship research.

To illustrate our arguments, the remainder of this paper is structured as follows: Section 2 develops theory and hypotheses which will be operationalized through our research design, data collection and analysis (methodology, section 3). Section 4 comprehensively describes our descriptive and statistical results which will be mirrored to existing theory in our discussion (section 5).

3. Theory

3.1 Funding of new ventures: Agency problems, pecking-order theory and capital structure

A large variety of ways exists to categorize different venture funding options. They range from broad categorization of private and external funding (Gartner et al., 2012), over intermediate ones that in addition distinguish between external equity and debt (Frid, 2009), to the more detailed one introduced by Robb and Robinson (2014). The latter systematically characterize funding options along two dimensions: namely their source and type. The source indicates which type of actor provides funding to the venture, including founders, insiders (spouses and parents) and outsiders (banks, other businesses, government agencies, and venture capitalists). The type, in turn, indicates whether funding is provided in exchange for shares (equity) or has to be repaid with (or without) interest (debt).

In this article, we largely follow this categorization by Robb and Robinson (2014), whereby we distinguish between different finance sources only with regard to equity in order to increase comparability to existing studies of the broader finance literature (Bhide, 1992; Cumming, 2005a; Kotha and George, 2012). For the same reason, we also account for a third type of funding, namely grants, which are provided without requiring any transfer of shares or a payback (Auerswald and Branscomb, 2003; Feldman and Kelley, 2006). Accordingly, we here account for founder equity, insider equity (Ang, 1992) and external equity (Carpenter and Petersen, 2002), as well as debt finance and grants (Berger and Udell, 2006) as the major funding options of new ventures (see Table 1).

Table 1: Categorization of Funding

Type	Source
Equity	Founder Insider External
Debt	-
Grant	-

The defining characteristic of nascent ventures in relation to acquiring these different types of funding is their liability of newness and often smallness (Parker, 2009; Sine et al., 2006; Stinchcombe, 1965). These traits generally manifest themselves in information opacity, as well as a lack of a track-record and tangible assets (Aldrich and Fiol, 1994; Cressy, 2002). This results in a situation where conveying credible information to potential funders is often either prohibitively expensive or not possible (Berger and Udell, 1998), thus a situation of asymmetric information between the founder of the venture and a potential funder (Lee et al., 2015; Mina et al., 2013; Stiglitz and Weiss, 1981).

Information opacity and asymmetric distribution of information give rise to agency problems that can influence the ability of ventures to acquire funding as funding body and venture are usually two different entities. Agency problems can take the form of adverse selection (Jensen and Meckling, 1976) and moral hazard (Cumming, 2005b; Eisenhardt, 1989). The former describes a situation in which the agent's (the entrepreneur) signals about the quality of the venture cannot be observed or verified by a prospective principal (the funder) (Cumming, 2005b; Eisenhardt, 1989). Depending on the signals used by the agent, the principal's decision making process is thus flawed, so that the wrong investment option (venture) is selected. The latter exemplifies an incomplete contract after closing the deal between principal and agent, under which the agent potentially uses funding not in the best interest of the principal (Busenitz et al., 2005). In addition, depending on the set-up of the contract, the principal has limited influence or sanctioning mechanisms vis-à-vis the agent (Kaplan and Strömberg, 2004).

Founders of ventures are faced with the challenge of overcoming adverse selection and moral hazard problems in order to secure the required funding, while they also need to optimize the cost of capital and to retain control over their venture. In light of these tensions, the so-called Pecking Order Theory (POT) of funding has emerged (Hechavarría et al., 2016; Myers and Majluf, 1984). POT proposes that agency problems entail a distinct order of attractiveness and, thus, accessibility of different funding types and sources. This, in turn, leads to a linear process in which ventures try to acquire these different funding options. The assumed order of preference expects ventures to first exhaust (1)

founder and (2) insider equity. Once these funding options are no longer viable, ventures approach (3) debt providers and only in a last step (4) external equity providers such venture capitalists (Berger and Udell, 1998; de Bettignies and Brander, 2007; Michaelas et al., 1999; Myers and Majluf, 1984).

Graph 1: Adverse Selection and Moral Hazard in POT

The mechanisms underlying this pecking order are the following: A venture funded by its founders has by definition no agency problems (adverse selection or moral hazard), because ownership and control are in the hands of the same person(s), making it cheap and easy to access this funding source (Cosh et al., 2009; Hechavarría et al., 2016; Norton, 1991). While this does not hold for funding through insider equity (Ang, 1992; Kotha and George, 2012), information asymmetries between insider equity providers and the venture are less pronounced because of the equity providers' personal relationships to the founders and, thus, their social control and informal access to venture information (Cable and Shane, 1997; Cornelissen and Clarke, 2010; Shane and Cable, 2002). Accordingly, debt and external equity providers suffer most from adverse selection problems as they have no social network ties to overcome asymmetric information. These agency problems induce debt and external equity providers to ask for a premium to fund new ventures (Akerlof, 1970). This, in turn, makes external funding more expensive and thus less attractive for ventures vis-a-vis founder and insider funding (Cumming, 2005a; Vanacker and Manigart, 2010).

3.2 A process perspective on funding acquisition: Sequences and transition

Taking the pecking-order-theory as a reference point (Cumming, 2005a; Frank and Goyal, 2003; Myers and Majluf, 1984; Robb and Robinson, 2014), we assume that the funding acquisition process typically starts with the founders own resources, is followed by the acquisition of insider funding and, finally, by acquiring external (institutional) funding. While little is known about the (determinants of) transition between the funding phases (Cassar, 2004; Gartner et al., 2012), a variety of factors have been identified that help nascent ventures overcome agency problems and gain access to external funding sources (Burns et al., 2016).

First, hiring (experienced) employees signals a venture's legitimacy to external funders and can thus help to mitigate the liability of newness problem (Busenitz et al., 2005). Contrary to that, ventures that do not hire employees tend to have rather limited growth ambitions (Gartner et al., 2012; Storey, 1994). These ventures typically do not require as much funding and, as a result, are more likely to satisfy their funding needs through finance provided by the founders themselves (Avery et al., 1998; Kotha and George, 2012; Renko, 2013). We therefore expect nascent ventures that do not hire any employees to be restricted to founder funding, both by the lack of supply and demand for external funding. In contrast, we expect ventures hiring at least one employee to make use of external funding sources once the founder resources are exhausted.

H1: *Ventures that do not hire employees are less likely to acquire funding after acquiring founder equity.*

Second, and in line with the pecking-order-theory, ventures developing novel products can be expected to be financed by a combination of grants, internal and external equity (Islam et al., 2018). As research and development (R&D) of novel products is generally a highly uncertain process, grants are likely to be among the first funding sources accessed by innovative nascent ventures (Auerswald and Branscomb, 2003; Burns et al., 2016; Polzin et al., 2018). Furthermore, the investment amounts required for R&D processes are large. They often exceed the resources of the venture founders, forcing the latter to acquire funding from external funders, who often contribute not only funding but also knowledge and access to their networks (Barney et al., 1996; Hsu, 2006; Sorensen, 2007). In addition, a recent study by Islam et al. (2018) found that being awarded a prestigious research grant also increases the likelihood of subsequently acquiring venture capital. Therefore, and due to the resulting growth expectations of innovative ventures, we expect innovative ventures to not tap into insider capital sources (Kotha and George, 2012) but to directly approach institutional investors or grant providers (Bertoni et al., 2016; Gompers and Lerner, 1998):

H2: *Innovative ventures are more likely to acquire external equity or grants after acquiring founder equity.*

Third, ventures that seek to invest funds into tangible assets or products have a larger chance to use these assets as collateral in the funding acquisition process. This, in turn, is attractive for banks as they might be able to (partly) recover their investments in case of venture failure. As a result ventures producing tangible products can more easily overcome the liability of newness which often prevents nascent ventures from acquiring debt (Berger and Udell, 1998; Cosh et al., 2009). Product developing ventures are also are more likely to pursue economies of scale and thus require larger investments compared to ventures that are 'asset-light' service providers (Bertoni et al., 2016; Polzin et al., 2018; Winton and Yerramilli, 2008). Consequently, the funding needs of product developers are likely to exceed their founders' resources, which leads them to seek external financing options (Lee et al., 2015; Mina et al., 2013; Winton and Yerramilli, 2008). Taken together, ventures producing tangible products are thus more likely to seek and gain access to debt finance after the investment of founder equity (Berger and Udell, 2006, 1998):

H3: *Ventures that produce tangible products are more likely to acquire debt after the investment of founder equity*.

4. Methodology

4.1 The Data: Sample and operationalization

To test the aforementioned hypotheses, we use the "Perfect Timing" (PT) database. Based on computer-assisted telephone interviews with founders, we collected this dataset in two waves between 2011 and 2018 by an international research team located in Utrecht (The Netherlands), New York (US), Germany (Düsseldorf and Cologne), London (UK), and Palermo (Italy). In order to capture possible variations in venture creation processes, the population interviewed includes ventures of all legal forms (excluding sole proprietorship) that were registered between 2004 and 2014 in the information technology (IT) and renewable energy (RE) industries in Germany, Italy, the US, the Netherlands and the UK. From this population, founders were randomly selected and invited to participate in an interview about the venture creation process of their company until a representative sample of 755 cases had been obtained.

We collected the data with an explicit focus on the timing and sequencing of venture creation activities, which also allows us to discern patterns in funding acquisition processes (dependent variable) on a monthly basis. Importantly, the dataset is restricted to the duration of the initial phase of the venture creation process. This process begins with the first time a founder talked with someone else about setting up the venture in question; it ends at the moment when the venture generated sustainable profits (defined as 3 consecutive profitable months). If a new venture never made sustainable profits, three alternative process ends can occur: namely the acquisition, merger or liquidation of the respective venture. If none of these events occurred until the date of the interview, the process of venture creation was categorized as ongoing and recorded up to a maximum duration of 84 months.

Dependent variable: The funding acquisition process

For the purpose of this analysis we only consider that part of the venture creation process which is relevant for a ventures funding. Accordingly, we consider the first time the venture starts acquiring any type of finance as the starting point of the funding acquisition process; its end date corresponds to the end date of overall venture creation process as described above. Throughout this process, we report the funding acquisition activities undertaken on a monthly basis. Thereby, each funding activity is recorded, starting with the month in which the venture approached a funder and ending with the moment in which the venture actually received funding. This definition of funding acquisition ensures the comparability across cases. Accordingly, we only record funding acquisition activities that were successful, thus led to the actual acquisition of funding. Failed attempts to acquire funding are not recorded. Furthermore, months during which a venture was not actively acquiring any type of funding are ignored for the purpose of the analysis. While this approach reduces the explanatory power of our analysis with regard to differences in the length of funding activities, it allows us to gear the analysis towards exploring the sequence of funding acquisition activities. Given that the latter is at the basis of pecking-order theory, this approach is most appropriate for the theoretical aim of our paper to shed light on the POT arguments.

In order to create a typology of funding acquisition processes, we determine the state of funding acquisition for each month of venture creation. The respective state of funding acquisition represents the funding types and sources acquired for each month. In line with the literature, we distinguish between equity, debt and grant as types of funding. We furthermore follow the literature by determining from which source equity was acquired. As a result we distinguish between five different states, representing five combinations of different funding types and sources, namely Founder Equity, Insider Equity, External Equity as well as Debt and Grants.

Of course, a venture can simultaneously acquire funding from more than one source and of more than one type. Consequently, these five type/source combinations can co-occur during the funding acquisition process. In order to keep the number of possible states manageable and comparable to previous work (Gartner et al., 2012; Robb and Robinson, 2014) we consider eight, individual and aggregate states (listed in Table 2) at which we arrive in the following two-step approach.

Table 2: Coding the Funding Source/Type states

		Funding Type			
		Equity	Debt	Debt & Equity	Grant
Equity Source	Founder	FE		D&FE	
	Insider (& Founder)	IE	D	D&IE	G
	External (& Founder, Insider)	EE		D&EE	

In the first step (1), we reduce the number of states whenever a venture is simultaneously acquiring multiple types of equity. In these cases, we give preference to that type of equity which, according to POT theory, is most difficult to acquire. The POT order considers external equity as most difficult and founder equity as the least difficult to acquire.

In a second step (2), we code all states in which grant acquisition co-occurred with any other type of funding acquisition as a 'grant-only' state. This coding approach is based on the assumption that acquiring grants is such a unique and time-intense activity that it is basically irrelevant if and what other type of funding is acquired simultaneously.

We illustrate these two aggregation steps by the hypothetical funding acquisition process exemplified in Table 3: For the first two months, the hypothetical venture is exclusively financed through the equity of its founder. In month 3, the venture starts acquiring equity from an insider (i.e. family member or friend). Consequently, and as described in step (1) above, we aggregate the simultaneous acquisition of founder and insider equity to the state 'acquiring insider equity' (IE). The same happens in month 5, when the venture acquires all three equity types simultaneously. Again in accordance with aggregation step (1), we code this state as 'acquiring external equity' (EE) as the latter is the most difficult equity source to acquire. In month 6, the venture starts acquiring debt finance in parallel to founder equity and external equity which is coded as 'debt and external equity acquisition' (D&EE). Finally, and in accordance with step (2), we aggregate the simultaneous acquisition of debt and grant in month 9 to the state 'grant acquisition' (G).

Table 3: Example of a Funding acquisition process

Source	Type	Month									
		1	2	3	4	5	6	7	8	9	10
Equity	Founder	FE	FE	FE	FE	FE	FE	FE			
	Insider			IE	IE	IE					
	External					EE	EE				
Debt							D	D	D	D	0
Grant										G	G
Funding State		**FE**	**FE**	**IE**	**IE**	**EE**	**D&EE**	**D&FE**	**D**	**G**	**G**

The row "Funding State" aggregates the funding acquisition activities for every month as outlined above, thereby reporting the entire funding acquisition process of our hypothetical venture.

Independent Variables: Contextual factors

We measure the different contextual factors that may influence which funding acquisition process is pursued by a new venture as follows (Aldrich and Fiol, 1994; Li and Zahra, 2012; North, 1990). We use World Bank data on bank loans given to the private sector (Demirgüç-Kunt and Maksimovic, 2002) and the volume of the stock market (Li and Zahra, 2012) to characterize the financial framework a venture operates in (Hirsch-Kreinsen, n.d.; Lerner and Tag, 2013; Migendt et al., 2017).

In relation to the GDP in year and country of the venture's registration these two values allow us to control for the financial conditions a ventures was set up under.

The innovativeness of a venture's business idea was determined in a three-step process. In the first step, the founder was asked whether her business develops a radically new, incrementally new, or imitative product or service.[1] In a second step, the interviewer (upon completion of the interview) cross-checked the founder's answer by comparing the venture's innovativeness with the innovativeness of the other ventures with which s/he had conducted interviews. In a third step, the person cleaning the data, again, cross-checked the degree of innovativeness indicated against the classification scheme he had developed while cleaning the entire dataset. In both step two and step three, the interviewer and the data cleaner relied on the information provided by the founder as well as on online information about the venture's business idea. This three-step process made it possible to minimize the over-estimation bias that typically occurs when founders self-report the level of their business' innovativeness. The degree of innovativeness is measured as imitation / improvement (0), or radical innovation (1).

Table 4: Dataset descriptives

Variable	Value	N	in %
Country	US	198	26,2%
	UK	118	15,6%
	Germany	282	37,4%
	Italy	124	16,4%
	Netherlands	33	4,4%
Innovativeness	Not Radical	658	87,2%
	Radical	97	12,8%
Type of Good	Service	235	31,1%
	Mix	394	52,2%
	Product	126	16,7%
Zero Employees	No	314	41,6%
	Yes	441	58,4%

[1] Concrete question asked in the questionnaire: 'How would you describe the degree of novelty of your venture`s core business idea?'

Industry	ICT	508	67,3%
	RE	247	32,7%
PT Solo founder	No	699	92,6%
	Yes	56	7,4%
Legal Type	Unlimited	90	11,9%
	Limited	665	88,1%

The second variable included in our analyses is the type of good a venture produces. We assert whether a venture produces a tangible product (0), offers only services (2), or provides a mixture of both (1). This variable was recorded in the same three-step process as the ventures innovativeness.

Furthermore, we distinguish between ventures that never hired an employee throughout the venture creation process (1) and those who hired at least one employee (0).

Industries are structurally different and induce ventures to pursue different business models, requiring distinct organisational structures (Sine et al., 2006) and thus different funding strategies (Gartner et al., 2012). Therefore, a venture's industry was included as a control variable. It was determined in a three step process, where ventures were first sampled on the basis of NAICS industry codes and their business descriptions. In a second step, the person cleaning the samples drawn confirmed a venture's industry affiliation through online information, such as the venture's website. Finally, the founder was asked to confirm the venture's industry affiliation as part of the interview. We group ventures into ICT (0) and Renewable Energy (1) ventures. Ventures that have an affiliation with both industries are classified as RE ventures.

Controlling for ventures that are led by solo part-time founders allows us to single out founders who neither have major growth ambitions nor want to share decision-making power with others, which makes them likely to exclusively rely on founder funding. We group ventures into those set-up by a solo part-time founder (1) and those with all other founder (team) constellations (0).

Finally, we control for the legal form under which a venture was incorporated. The literature is divided about the effect of legal forms limiting owner liability. Some argue that limited liabilities might induce ventures to seek more debts because founders are not personally liable for them with their private

assets (Gartner et al., 2012). Others argue that this is the exact reason why banks do not offer debt to ventures incorporated under limited liability forms (Berger and Udell, 1998; Carter and Van Auken, 1990). While remaining agnostic about the effect of limited liability on debt funding, we code limited liability ventures as (1) and ventures registered under personally liable forms as (0).

4.2 Analyses

In line with our theoretical illustrations, we run two different types of analyses: **(1)** In a first step, we assess whether ventures follow the funding acquisition process as prescribed by the pecking order theory or deviate from this linear path. To this end, we illustrate what the most typical funding acquisition processes look like. To identify these processes, we use optimal matching (OM) techniques combined with cluster analyses, whereby the funding acquisition process constitutes the unit of analysis. The OM algorithm measures the distance between processes. If subsequently paired with cluster analyses, such sequence analyses allow us to explore and interpret patterns in longitudinal data (Halpin, 2010).

We apply OM techniques because, when compared to other methods, OM has been found to deliver superior results in identifying patterns in sequence data in the context of management science (Biemann and Datta, 2014).

Given that more wide-ranging developments and applications of OM algorithms only occurred after the year 2000, OM can still be considered a fairly young method. Nevertheless, a standard way of running sequence analyses, based on OM techniques, has crystallized, which we here follow (Biemann and Datta, 2014). It includes four steps:

Step 1: Coding the Data

The first step consists in reporting the funding acquisition process of each venture on a monthly basis. More concretely, this means that a sequence of funding states, describing each venture's funding acquisition process, needs to be created for each venture. The reported funding acquisition process can vary in length for each venture as the length is a result of time that passed between the first funding activity and the end of the venture creation process.

As outlined under section 3 we ensure comparability with previous studies by distinguishing between 8 different possible values for funding state of a venture, namely:

- Founder Equity (FE)
- Insider Equity (IE)
- External Equity (EE)
- Debt (D)
- Debt & Founder Equity (D & FE)
- Debt & Insider Equity (D & IE)
- Debt & External Equity (D & EE)
- Grant (G)

Step 2: Define the Substitution Costs

In order to measure the distance between two funding acquisition sequences (as created in step 1), a cost needs to be assigned for replacing one state by any other state with the aim of transforming one sequence into the other. These so-called substitution costs range from 0 to an arbitrary maximum (here: 2) and are estimated on the basis of the relative frequency of transitions between two states within the entire dataset. Based on this transition frequency between any two funding states, a so-called substitution cost matrix is determined.

The substitution cost matrix obtained for our dataset intuitively makes sense as the substation costs are lowest to transform each equity state into the same equity state combined with debt. For transformations of debt, costs are lowest for debt being transformed into any (of the three possible) combination/s with equity. Furthermore, it is overall less costly to transform grant funding into combinations with equity rather than with debt funding. Given that these transitions costs reflect the pecking-order arguments about the relative ease with which ventures can access (different types of) equity as compared to debts and grants, the transition costs – while relatively similar – reflect the relatedness of funding acquisition states.

Table 5: Substitution Cost Matrix

	Founder Equity	Insider Equity	External Equity	Debt	Debt & FE	Debt & IE	Debt & EE	Grant
Founder Equity	0							
Insider Equity	1.980546	0						
External Equity	1.980546	1.992141	0					
Debt	1.976390	1.979856	1.987631	0				
Debt & FE	1.861760	2.000000	1.997812	1.893771	0			
Debt & IE	2.000000	1.945409	2.000000	1.932181	1.987395	0		
Debt & EE	1.983565	1.983871	1.871734	1.932824	1.981683	1.989583	0	
Grant	1.956760	1.993256	1.971531	1.984678	1.993435	1.989583	1.966571	0

Step 3: Calculating Sequence Similarity

Based on these substitution costs, it is then calculated (for each of the 755 sequences in our dataset) how costly it is to transform one sequence into any of the other 754 sequences. The cost of transforming one sequence into the other expresses their respective distance. To determine the distance of sequences that differ in length, we calculate their distance based on the length of the shorter of the two sequences. This reflects that the shorter of the two funding acquisition processes is unknown beyond the period observed and should thus not influence the distance measure. This novel solution was introduced in Held et al. (Held et al., 2018) and addresses an often voiced concern of using OM for analysing sequences in social science that vary greatly in length (Aisenbrey and Fasang, 2010)..

Furthermore, we normalize the respective values of sequence difference by dividing them by the length of the shorter of the two sequences in order to maintain a comparable difference measure across sequence pairs. This results in a matrix which reports the distances between each sequence pair.

Step 4: Perform a Cluster Analysis

In the concluding step, the funding acquisition processes are clustered on the basis of their respective distances to one another. Consequently, each cluster obtained encompasses those processes that are particularly similar to each other, and distant to the processes of other clusters. Accordingly, each cluster represents one of the most frequent and, thus, typical approaches to funding acquisition. We run the cluster analysis based on the Ward's minimum variance method, which has been shown to

consistently produce the most accurate sequence clustering within the framework of OM analyses (Dlouhy and Biemann, 2015).

We use a combination of various partition quality measurements, namely the Weighted Average Silhouette Width (ASWw), R^2, Point Biserial Correlation (PBC), and Hubert's C (HC) to determine the optimal clustering solution amongst all solutions between one and twenty clusters. These measures indicate how similar sequences are within one cluster and how different they are between clusters. Consequently, we calculated these indicators for one, two, three, etc., up to twenty clusters in order to determine their goodness of fit. In this way, we could determine for which cluster number the goodness of fit is maximized. In doing so, we could exclude those cluster solutions which either did not yield distinct approaches, because they clustered together too different sequences, or which spread out sequences over too many similar clusters.

(2) In order to provide meaning and context to the results of an exploratory process analysis, the next step is to understand *"what factors cause the different sequences observed"* (Van de Ven and Engleman, 2004). We therefore use binary logistic regression models to identify the conditions that influence the pursuit of one funding acquisition approach (cluster) as compared to all other approaches (dependent variable). Testing *Hypotheses 1-3*, we determine the explanatory power of a venture's innovativeness, its type of good, as well as whether it hired employees (independent variables). In addition, we control for the venture's legal form, whether it is led by a solo part-time founder, and the financial conditions under which the venture was created (control variables).

We fit the following model for each cluster to obtain the estimates:

$$ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 Innovativeness_i + \beta_2 Product_i + \beta_3 Employees + \boldsymbol{\beta}' \boldsymbol{x}_i \quad (1)$$

where p_i denotes the probability that venture i belongs to the cluster rather than to any of the other clusters, β_0 the cluster's intercept, β_1, β_2, and β_3 the estimated coefficients for our independent variables, $\boldsymbol{\beta}$ a vector of coefficients for the control variables, and $\boldsymbol{x}_i$ a vector of control variables.

5. Results

5.1 Funding types and sources

Before running the aforementioned analyses, we look at some data descriptives: When looking at the order in which funding was acquired (Table 6), we observe, that three quarters of the ventures in our sample receive the first funding from their founders. While this supports a fundamental assertion of the POT theory, it also means that one quarter of the ventures do not follow the POT expectations already from the beginning of their funding acquisition process. In addition, almost 10% of the ventures receive their first funding from equity insiders, which according to POT also belong to the earliest funding forms that ventures typically acquire. Nevertheless, a significant group of ventures remain that acquire their initial funding from debt providers, which runs counter to POT expectations.

Table 6: First funding acquired

1st funding acquired	N	**in %**
Founder Equity	568	75.3%
Insider Equity	64	8.5%
Debt	50	6.6%
Grant	22	2.9%
Debt & FE	17	2.3%
External Equity & FE	15	2.0%
External Equity	12	1.6%
External Equity & IE	3	0.4%
Debt & IE	2	0.3%

Debt & EE	1	0.1%
Total	755	100%

When we do not only look at the first type of funding acquired, but also include the second type of funding that was acquired (see Table 7), the picture gets even more differentiated, and we find further evidence, that most funding acquisition processes are largely in line with the expectations of the POT. However, these results are also indicative of a great variety of different funding acquisition processes amongst nascent ventures.

Table 7 depicts the five most common sequences of the first two funding types that ventures acquired. These five sequences make up 80.8% of our sample. Interestingly, more than half of the ventures never acquire any other funding type than the investment they received from their founders (55.6%). Only 10.6% of ventures follow up on the initial founder investment received with the acquisition of debt. However, almost half as many ventures (namely 4%) first acquire debt and then receive funding from their founders.

Table 7: First two types of funding acquired

1st / 2nd funding acquired	N	**in %**
FE / -	419	55.6%
FE / Debt	80	10.6%
FE / Grant	41	5.4%
IE / -	39	5.2%
Debt / FE	30	4.0%
Total	609	80.8%

This picture gets even more diverse when we consider that the remaining 19.2% of the sample are distributed over 37 different sequences with regard to their first two funding acquisitions. In order to

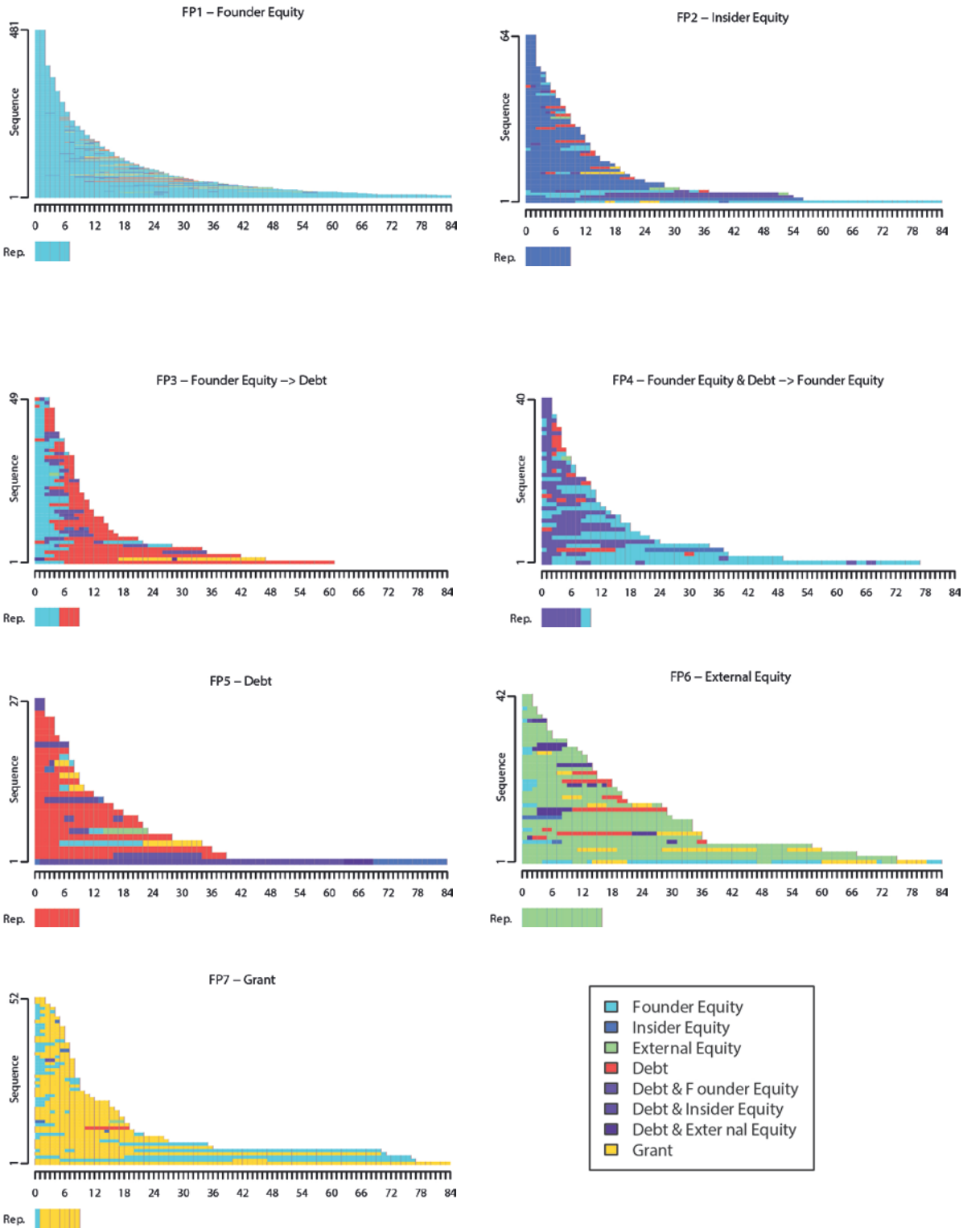
explore this variety in greater depth, we now carry out the aforementioned OM sequence analysis. This does not only allow us to include more than two funding acquisitions, it also introduces the length of time it took ventures to acquire these funding types. In other words, it allows us to depict the actual funding acquisition process instead of singular funding acquisition events.

5.2 Patterns in Funding acquisition processes

As outlined in the theory section, the funding acquisition processes of ventures have been researched at the meta level, so that our research question *"Do nascent ventures pursue different approaches to funding acquisition and, if so, how do these processes look like?"* has never been answered. The partition quality measurements identify the solution of 7 clusters (out of the overall 1-20 solutions considered) as optimal (ASWw = 0.75; R^2 = 0.82; PBC = 0.83; HC = 0.04). Each of these 7 clusters (reported in Figure 1) represents one of the most typical funding acquisition processes with regard to its funding types and sources, as well as the timing and sequence in which funding is acquired. As a result, we can answer the first part of our research question with "yes": nascent ventures pursue one of overall seven distinct approaches to funding acquisition.

Moving on to the second part of the research question, the results obtained from OM analyses also make it possible to illustrate what these funding acquisition processes look like. For each of the seven clusters, Figure 1 provides an overview of all funding acquisition approaches within the cluster, as well as the most representative process. The most representative process (Rep.) depicts the modal funding state for each month of the median process in each cluster. The distribution over these seven processes is highly skewed towards cluster 1 (FP1): The 481 ventures pursuing the approach depicted in cluster FP1 largely fund themselves through their founders' equity. The process is rather static in that only a few ventures add other funding sources at all; and those who do so, acquire additional funding rather late in the process. The dominance of one static funding process based on founder equity contradicts the expectations formulated in the POT in so far as POT expects ventures to routinely transition to other funding options.

Figure 1: Distinct Funding acquisition processes



The second largest cluster (FP2) features ventures that largely depend on insider equity. As defined above, this state also encompasses months in which both founder and insider equity are

simultaneously acquired. Cluster FP2 thus depicts a funding acquisition process sponsored by both the venture founders and their immediate network.

Clusters FP3 and FP4, in turn, report two opposing approaches characterised by the combination of founder equity and debts. Most ventures combine these two funding sources in a dynamic transition process from founder equity to debt after about six months (FP3). However, ventures pursuing the approach depicted in cluster FP4 proceed the other way around: They begin with acquiring debt and, after about six months, turn to acquiring founder equity. While the number of ventures pursuing this approach is comparatively limited (n = 40), the existence of these two opposing approaches to debt and founder equity runs counter to the POT assumptions.

Cluster FP5 is rather small (n = 27) and clearly dominated by ventures that finance themselves almost exclusively through debt. This finding is particularly interesting, considering that debt is often assumed to be out of reach for nascent ventures.

Ventures pursuing the approach of cluster FP6 strongly focus on acquiring external equity. In view of the attention paid to institutional equity both in public discussions and in the literature on venture funding, it is surprising how small the number of ventures is that belong to cluster FP6.

Finally, cluster FP7 features those ventures that acquire a grant as part of their funding acquisition process. This mostly happens in combination with initial equity provision by founders, which often continues throughout the grant application phase.

5.3 Determinants of approaches to the Funding Acquisition Process

After establishing the existence of seven distinct funding acquisition processes and describing their basic differences, we want to understand what factors influence the ventures' choice to follow a particular acquisition process. In other word, what drives the differences in the funding acquisition processes of ventures (Table 8)?

Our first hypothesis is that ventures which do not hire employees are less likely to seek other forms of funding after acquiring founder equity (H1). We find clear evidence in support of this hypothesis: Ventures pursuing the acquisition process depicted in cluster FP1 (founder equity only) are two times

as likely as other ventures in our sample to never hire any employees (FP1; Exp β = 2.049; p < .01). Ventures pursuing all other funding approaches (except the one depicted in cluster FP5) are less likely not to hire employees. Even though this finding is statistically significant only for clusters FP3 (Founder Equity -> Debt) and FP6 (External Equity), the regression results overall can confirm H1.

Table 8: Regression estimates for funding acquisition process clusters

	Funding acquisition process cluster (Exp β)						
Variable	FP1	FP2	FP3	FP4	FP5	FP6	FP7
Type of Good - Mix	1.15	.632	1.121	.694	.85	1.199	1.074
- Product	.421***	.982	2.7**	2.635**	2.924*	.631	1.653
Degree Novelty	.626*	1.54	.419	.196	.858	4.012***	2.032*
Legal Type	1.014	1.55	1.118	.936	.487	4.291	.536
Solo PT Founder	.714	2.386**	.603	1.114	.272	1.668	1.375
Zero Employees	2.049***	.851	.554**	.696	1.223	.208***	.661
Industry	.579***	.595	2.965***	1.966*	2.157*	1.404	.967
Loans to Private Sector (in % of GDP)	1.005	.989	1.021**	.999	1.01	.99	.983**
Stock Market Volume (in % of GDP)	.992	1.013	.981*	.995	1.003	1.007	1.021**
Intercept	1.499	.135***	.012***	.079***	.008***	.038***	.203**
Observations in Cluster	481	64	49	40	27	42	52
R^2	.117	.038	.116	.122	.086	.165	.051

p-values *** < .01, ** < .05, * < .1

With regard to the ventures' innovativeness, we hypothesized that ventures developing radically new products are more likely to receive external equity and grants after the initial founder investment (H2). This hypothesis is confirmed by the finding that the approaches relying chiefly on external equity (FP6) and grants (FP7) are significantly more likely to be pursued by ventures developing radically new goods (FP6; Exp β = 4.012; p < .01 / FP7; Exp β = 2.032; p < .1).

We also find proof of our third hypothesis (H3), which proposed a relationship between the type of good a venture produces and the likelihood of acquiring debt funding in addition to the founders' investment. We observe that ventures producing tangible products rather than services are highly unlikely (FP1; Exp β = .421; p < .01) to acquire any other funding than their founders' investment (FP1). Instead, product developing ventures are highly likely to acquire debt funding after, or even instead of, founder equity (FP3; Exp β = 2.7; p < .05 / FP4; Exp β = 2.635; p < .05 / FP5; Exp β =

2.924; $p < .05$). We therefore conclude that there is a positive relationship between product developing ventures and their acquisition of debt funding.

Furthermore, we observe that the financial environment has hardly an effect on the funding approach pursued by nascent ventures. Although there is significant relation between both the volume of loans provided to the private sector and the volume of stock market capitalization and clusters FP3 and FP7, the effect size is rather small. Yet, as one might expect, ventures in countries where higher amounts of loans are provided to the private sector are more likely to seek debt finance after founder equity (FP3), while ventures in environments with high stock market capitalization are less likely to do so. Interestingly, the two environments have the opposite effects on the likelihood of acquiring grants (FP7), which seems to indicate a substation effect between grants and debt.

Out of the remaining control variables, two prove to be significantly correlated with distinct funding approaches. Accordingly, we observe that ventures active in the renewable energy sector are less likely to solely finance themselves through founder equity (FP1) but instead choose debt-based funding approaches (FP3, FP4 and FP5). Considering that ventures in the renewable energy sector are more likely to require larger scale production machinery than their counterparts in the ICT sector, these collaterals may well explain why renewable energy ventures – like product developing ventures – find it easier to obtain debt finance. Finally, we find interesting correlations between solo part-time founders and their funding acquisition approaches, who are likely to not only finance their venture themselves but together with insider equity providers (FP2; Exp $\beta = 2.386$; $p < .05$).

5.4 Cluster descriptives – Funding sums, success rate and process length

In order to further explore distinctive characteristics of each of the funding acquisition processes identified, we analyse the average amount of funding a venture received pursuing each approach. Given that the founders interviewed were often reluctant to provide information about the funding amounts received, the case number is overall too limited for running statistical analyses. Nevertheless, the descriptive data provides interesting insights into further differences between the funding acquisition processes (Table 9).

The funding approach with the lowest average investment is FP1 (Founder Equity), because only very few ventures pursuing this approach receive funding other than founder equity. In view of the low amounts invested by founders, the average total funding acquired by ventures pursuing this approach is decisively lower than that of other approaches.

In contrast, the two funding processes characterize by a transition from founder equity to debt (FP3 and FP4) acquire by far the highest average funding amounts (3,863 k €, respectively 3,229 k€). These amounts are driven by large debts rather than the founder equity invested.

The funding processes of clusters FP6 (external equity) and FP7 (grant) seem diametrically opposed with regard to the funding types they tap into. While ventures focusing on the acquisition of external equity (FP6) also receive the highest amounts thereof but hardly any founder equity, the opposite holds true for ventures focusing on grant acquisition (FP7), which chiefly finance themselves through founder equity.

While incomplete, the data on the funding amounts obtained allows us to conclude that debt is by far the most important funding source, followed by external equity and grants. Together with insider equity, founder equity – which constitutes the first founding source for almost all ventures – is least important in terms of the amounts received. These findings are in line with the capital structure literature (Robb and Robinson, 2014; Sogorb-Mira, 2005) and thus corroborate the reliability of our dataset. Combined with the above cluster analysis, we can show that funding acquisition processes of nascent ventures do not only differ in the sequence of funding types, but also in terms of the weight the funding types carry and overall investment sums.

Table 9: Average amounts of funding received per cluster (in € thousand)

Funding Source	FP1	FP2	FP3	FP4	FP5	FP6	FP7	**Overall**
Founder Equity	91	141	93	310	26	75	1301	**104**
(n)	256	20	25	15	5	15	19	**355**
Insider Equity	63	34	15	NA	8	66	17	**36**
(n)	2	24	1	0	3	4	2	**36**
External Equity	110	205	NA	396	NA[2]	697	50	**590**

[2] A single outlier case is not considered here

(n)	1	1	0	1	0	20	2	**25**
Total Equity	92	161	94	336	30	767	130	**154**
(n)	256	24	25	15	5	20	20	**365**
Debt	783	1,089	3,769	3,100	467	663	1,397	**1,940**
(n)	22	6	25	14	15	6	3	**91**
Grant	166	66	NA	NA	NA	416	158	**173**
(n)	7	1	0	0	0	2	22	**32**
Total Funding	164	436	3,863	3,229	477	1,007	466	**632**
(n)	256	24	25	15	15	20	22	**377**

In a last step, we use three output measures to complement our analyses with data on the outcome of the seven funding acquisition processes, namely the *success rate*, *profitability* and *length of venture creation*. We find that the seven processes differ with regard to these three output indicators. Table 10 provides an overview for each funding acquisition process. As illustrated above (see section 3), venture creation *success* is defined as sustainable profitability, i.e. as making profits for three consecutive months. Venture *profitability* is indicated as the profits made by ventures during these three months. The *length of venture creation* is calculated as the duration between idea conception and the end of venture creation.

Given that cluster FP1 (founder equity) is so large, it is hardly surprising that it displays values close to the average on all three indicators. Interestingly, those ventures that focus on acquiring external equity (FP6) and grants (FP7) are characterised by the lowest success rate and the longest average processes. These findings further corroborate hypothesis H1, if we consider that debt providers are unlikely to invest in highly innovative and, thus, risky ventures Interestingly, ventures funded by external equity differ from ventures funded by grants most notably in the profits generated by successful ventures: Successful ventures backed by external equity are substantially more profitable during their first three profit months than ventures funded by grants. Ventures funded by grants do thus not only take longer to achieve profitability but also create lower profits than ventures funded by external equity.

Table 10: Succes measures of venture creation

Variable	FP1	FP2	FP3	FP4	FP5	FP6	FP7	**Overall**

Success rate	90%	83%	94%	85%	96%	67%	77%	**87%**
Profit (€)	24,507	16,362	28,639	33,070	24,665	27,798	17,465	**24,366**
(n)	187	16	16	10	17	13	15	**274**
VCP length (month)	31	34	35	31	37	48	42	**33**

The high success rate of ventures relying on debt finance (approaches FP3 and FP5) is noteworthy but hardly surprising in view of the risk aversion of banks. Lastly, we find that insider backed ventures (FP2) display a success rate and profitability that are both below average. Whether this means that ventures with less attractive business proposition use insiders as funders of last resort, or miss input from professional funders, requires further investigation.

6. Discussion and Conclusions

The funding that (nascent) ventures acquire has been shown to influence their survival, speed and performance (Berger and Udell, 1998; Hechavarría et al., 2016; Shane and Venkataraman, 2000). Although a growing literature provides an initial understanding of the interplay between context and venture funding, research on the funding acquisition processes of nascent ventures is still limited (Block et al., 2018; Cassar, 2004; Drover et al., 2017).

With this study, we are able to bring the funding acquisition process of the individual venture to the forefront (Cassar, 2004). Instead of being obscured by contradicting trends in meta-data on investment volumes, we are able to discern distinct funding acquisition processes at the venture level, thereby aiming to contribute a more fine grained view on nascent venture funding. Extending previous work on start-up financing in general (Bhide, 1992; Cassar, 2004; Gartner et al., 2012; Vanacker and Manigart, 2010; Winton and Yerramilli, 2008), and pecking-order theory in particular (Frank and Goyal, 2003; Myers and Majluf, 1984; Robb and Robinson, 2014), our analyses reveal that seven distinct funding acquisition processes exist. Interestingly, by far the most common process is a static one that almost exclusively relies on equity provided by the venture's founders. While we observe a significant number of ventures to follow a process of transition, this transition usually sees ventures

move from founder equity based funding to debt based funding. In line with assumptions in recent discussions (Bertoni et al., 2015; Block et al., 2018; Drover et al., 2017; Islam et al., 2018), external investors provide funding only to a small number of nascent ventures (Ang, 1992; Kotha and George, 2012; Renko, 2013).

Our results allow for additional contributions on principal-agent problems as drivers of pecking-order financing as we are able to identify several factors that influence a venture's choices throughout its funding acquisition process. Our results show that factors reducing principal-agent (i.e. moral hazard and adverse selection) problems between funders and ventures have the expected effects (Block et al., 2018; Connelly et al., 2011; Drover et al., 2017): Ventures producing tangible goods are less likely to fund themselves chiefly through their founder's equity (Berger and Udell, 2006, 1998; Cosh et al., 2009; de Bettignies and Brander, 2007; Polzin et al., 2018; Winton and Yerramilli, 2008) and more likely to turn to debt funding early on.

Innovative ventures target external funding early on, whereby they are more likely to acquire external equity or grants than debt funding. These findings are not only in line with previous research based on panel data and balance sheet information (Gartner et al., 2012; Hechavarría et al., 2016; Robb and Robinson, 2014), they also corroborate the idea that external equity providers generally take on a more active advisory role than debt providers (Barney et al., 1996; Hsu, 2006; Sorensen, 2007).

The decision not to hire any employees seems to be an expression of limited growth ambitions, which induces ventures to mostly rely on their founders equity and renders them unsuccessful in acquiring external equity throughout the start-up process (Avery et al., 1998; Kotha and George, 2012; Renko, 2013). Why solo part-time founders do not only rely on their own funds but also strongly draw on insider equity requires further investigation.

Furthermore, our paper also offers an important methodological contribution. By applying optimal matching techniques to analyse funding acquisition processes, we illustrate how this novel methodological approach can be used in business and management research. Our research thus offers a methodological answer to the long-standing call for systematic insights into how venture creation processes unfold over time in general (McMullen and Dimov, 2013; Moroz and Hindle, 2012; Ruef,

2005; Ucbasaran et al., 2001; Van de Ven and Engleman, 2004) and funding acquisition process in particular (Dimov, 2010; Gartner et al., 2012; Hechavarría et al., 2016).

Our research is subject to a set of limitations. On the one hand, our dataset would have benefitted from both a larger N and a larger variety in terms of industry and country coverage. On the other hand, we almost exclusively included static drivers (such as a venture's industry, innovativeness, or goods developed) to explain variations in dynamic processes. Future research would benefit from including dynamic aspects (such as moments in which core activities take place) to assess their influence on the sequence and length of funding acquisition processes.

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Whom do I search for? Variances of Linkage Formation Processes of Nascent Ventures in New Product Development

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Content

1. Executive summary

Nascent ventures in knowledge-intensive industries establish external linkages to complement firm-level resources – a process of strategic importance because such linkages substantially contribute to the venture's performance. However, little is known about how, and under what circumstances, ventures create linkages to what kind of external partners to develop their product. Our paper aims to address this research gap by identifying patterns of when and how founders add more diversity to their ventures, and which characteristics drive this linkage formation process. Empirically, we identify distinct patterns of external linkages formation in new product development, the characteristics that drive the linkage formation process, and also identify those factors that hinder ventures to form them. Methodologically, our paper introduces the optimal matching technique to research on external linkage formation in new product development.

2. INTRODUCTION

Innovation and management scholars have emphasized that the breadth of external search substantially contributes to a firm's new product performance (Chapman, Lucena, & Afcha, 2018; Dahlander, O'Mahony, & Gann, 2016; Leiponen & Helfat, 2011; Meyskens & Carsrud, 2013). External linkages have been associated with a variety of positive outcomes, including greater product novelty and better new product performance (Hoang & Rothaermel, 2010; Nieto & Santamaría, 2007; Rothaermel, 2001), in particular for resource-scarce nascent ventures (Haeussler, Patzelt, & Zahra, 2012; Hoang & Antoncic, 2003; Meyskens & Carsrud, 2013). However, while firms increasingly rely upon external actors in their product development (Freitas, Clausen, Fontana, & Verspagen, 2011; Powell, Koput, & Smith-Doerr, 1996), we have little knowledge of how, and under what circumstances, nascent ventures create linkages to what kind of external partners. To put it differently, we do not know when and how founders or founder teams add more diversity to their ventures through external linkages. This paper aims to address this research gap.

We examine different patterns in linkage formation processes of nascent ventures in new product development. Building on the resource-based view of the firm which interprets firm behaviour as a search for competitive advantages, shaped by resource endowments and knowledge stocks (Ahuja, 2000; Alvarez & Barney, 2001; Wernerfelt, 1984), existing studies on external breadth generally suggest that broader partnerships allow ventures to access more diverse sets of knowledge and information (Ireland, Hitt, & Vaidyanath, 2002). The analysis of external partnerships, however, has been based on a somewhat coarse-grained analysis. With few notable exceptions (Fitjar & Rodríguez-Pose, 2013; Hoang & Antoncic, 2003; Hoang & Rothaermel, 2010; Meyskens & Carsrud, 2013; Rothaermel & Deeds, 2004), prior studies have not systematically distinguished between the two most important types of external linkages in new product development: External linkages that concern the (often early) research-oriented phase and the (often later) market-oriented phase. Ignoring the variance of these two very different functions of external linkages can lead to unclear results or, as Hoang et al (2010, p. 735) have put it, the risk of an "aggregation bias". We believe that a more fine-grained

understanding of linkage formation processes is important because it allows a better understanding of their variance, of their change over time, and of the characteristics explaining the formation of certain types of external linkages.

We build up our argument on March's (1991) framework on organisational learning which Rothaermel's et al (2004) have applied to external linkages in new product development. In doing so, we aim at a better understanding of why only certain external linkages are chosen (and not others). Rothaermel's et al (2004) framework recognizes that firms face two challenges in positioning themselves in a competitive environment: exploring new technological opportunities within research projects, and leveraging these opportunities by commercialising them. Building up on this framework, we argue that the selection of external linkages for new product development is based on different strategic goals (i.e. research vs. market orientation), and that it contributes to a better understanding of external linkage formation processes of nascent ventures. Doing so, we provide a new typology of how nascent ventures search for external partners over time by demonstrating a distinct variance in linkage formation patterns.

We then introduce a resource-based view perspective in order to examine the factors that drive a venture's decision to choose certain external linkages – research linkages, market linkages or a combination of both. We also make use of the resource-based view to better understand why ventures do not choose external linkages to develop a new product, even though it should improve a venture's competitiveness (Chapman et al., 2018; Dahlander et al., 2016; Leiponen & Helfat, 2011; Meyskens & Carsrud, 2013).

Taken together, we seek to address a missing perspective in the new product development and innovation literature as it applies to nascent ventures: The variance of linkage formation processes in new product development and their temporal component. We also analyse the factors driving the choice of specific linkage formations. Accordingly, our research addresses the research gap whether distinct types of external linkage formation processes of nascent ventures in new product development exist, how they differ, and which underlying factors explain their choice and combination.

We address these questions with a unique data set. To empirically derive patterns of external linkages in new product development, we use an unusually fine grained dataset documenting 402 nascent ventures in two knowledge intensive industries, the information and communication (ICT) and the renewable energy (RE) industries. Building up on intensive interviews with the ventures' founders, we construct a database covering up to 84 months of new product development and accompanying linkage formation processes. We also make use of the survey data to identify the underlying characteristics that drive linkage formation processes.

Our results show that a distinct variance in linkage formation patterns exists, both across ventures as well as across time. Ventures demonstrate very different strategies by either engaging in external research linkages, or by engaging in external market linkages, or by combining both. Further, we also identify the factors which drive the decision for the "opposite pole" in new product development, i.e. the decision to act "alone".

3. THEORY AND HYPOTHESES: WHAT DRIVES LINKAGE FORMATION OF NASCENT VENTURES IN NEW PRODUCT DEVELOPMENT?

We discuss our motivation for examining the variance of external linkages in new product development as it applies for ventures and review the literature on new product development. We then turn our attention to theorizing how the strategic search for complementary resources is likely to induce certain collaborative patterns, and how the availability of firm-level resources induce the readiness to build up external linkages. As we describe in greater detail below, these factors shape the emergence of the previously unexamined patterns of external linkages in new product development.

3.1 New product development and external linkages

New product development and innovation are important for a firm's competitiveness (Hoang & Rothaermel, 2010; Nieto & Santamaría, 2007; Rothaermel, 2001), and linkages to external actors are an important element within knowledge sourcing strategies (Carayannopoulos & Auster, 2010). Eisenhardt and Schoonhoven (1996) suggest that the resource-based view can help to better understand why linkages are formed: the access to complementary resources, in particular the access

to knowledge and information on technologies and markets (Ireland et al., 2002). Indeed, substantial empirical evidence has shown that firms, in particular resource-scarce ventures (Hoang & Antoncic, 2003), tend to establish ties to those actors that allow access to critical resources (Geletkanycz et al., 1997). This is why the ability to manage such linkages is considered to be a source of competitive advantage (Glaister, 1998; Ireland et al., 2002).

Specifying the structure and the content of external linkages, more, and above all, diverse linkages have been associated with better performance (Hoang & Antoncic, 2003). Knowledge needed for new products – which includes both, new products and new services (Easingwood, 1986) – has become increasingly complex and is increasingly distributed across various market participants, so that diverse linkages are crucial to facilitate knowledge transfer and learning, and to provide informational advantages (Chapman et al., 2018; Meyskens & Carsrud, 2013; Nieto & Santamaría, 2007). However, despite the recognition that the diversity of external linkages matter, little is known about their antecedents.

The antecedents of external linkage formation processes can be derived from the established exploration-exploitation framework of organizational learning (March, 1991) which Rothaermel et al (2004) have applied to learning in inter-firm linkages, and which also has influenced recent research on partnership diversity (Meyskens & Carsrud, 2013). According to this framework, external linkages allow ventures to mobilize resources, but depending on the resources which are needed, these linkages fulfil different functions: They may either support the *exploration* or the *exploitation* of knowledge.

Research linkages, providing access to new technologies and to innovative capabilities, are important for achieving higher degrees of novelty in the development of new products, and allow exploring *new knowledge*. These linkages include linkages to competitors, customers, suppliers or research institutes and universities. *Market linkages*, in contrast, constitute platforms to exchange information concerning potential markets, customers and suppliers, and facilitate the access to and distribution of products in particular markets. In this perspective, they allow the *new knowledge to be exploited*. They include actors like industry associations, NGOs and other social sector actors (Alvarez & Barney, 2001; Geletkanycz et al., 1997; Meyskens & Carsrud, 2013). In our analysis of external linkage formation

processes, we build up on this exploration-exploitation framework and differentiate between research and market linkages.

In a temporal view, research linkages are often built up in early stages and are combined with market linkages in later stages of the product development as the former provide new knowledge embodied in the prototype while the latter provide complementary resources like regulatory knowledge, knowledge of customers and particular markets, and distribution, transforming the new knowledge into a marketable product (Rothaermel & Deeds, 2004)[1]. As the nature of a venture's linkages has a bearing on the firm's level of product innovativeness (Rothaermel & Deeds, 2004), it is important for management and innovation scholars to better understand the underlying factors that drive the choice of these linkages over time.

3.2 Nascent ventures and complementary resources through external linkages

In the resource-based view of the firm, firm behaviour can be interpreted as a search for competitive advantages by getting access to resources not provided by the firms themselves (Ahuja, 2000). In this view, external linkages help firms to access complementary resources not available at the firm-level. As firms tend to search for complementary resources, this means that a firm's resource profile plays a decisive role in linkage formation processes (Ireland et al., 2002; Stuart, 2000). In the perspective of the resource-based view of the firm where the „coordination of resources [is] a core function" (Alvarez & Barney, 2001), an important function is attributed to the entrepreneur in searching and identifying the relevant complementary resources for her venture. Entrepreneurship means to identify lacking resources at the firm-level, and to complement them with external resources, provided by external linkages. Resource mobilisation and opportunity identification can therefore be understood as being the core elements within the entrepreneurial process or, more generally, the venture creation process (Hoang & Antoncic, 2003).

[1] (Stam, 2010) additionally has shown that ventures with central positions in industry networks positively impact new venture performance as being member in an industry association provides informational advantages.

In this context, external linkages can be understood as complementary resources provided external to the firm. These external linkages provide either technological or marketing knowledge, or a combination thereof. Obviously, the need for these external resources differs depending on the venture's characteristics: Ventures with highly innovative products will be different from less innovative ventures, and highly technically focussed ventures will be different from more ventures with more balanced skill sets. Though in both cases, external linkages provide complementary knowledge, the knowledge which is exactly needed differ dependent on the venture's characteristics.

Access to complementary technological and marketing knowledge for highly innovative new product ideas

Highly innovative products are characterised by new knowledge and new markets (Lechevalier, Nishimura, & Storz, 2014; Malerba, 2007). Ventures that aim at developing highly innovative products therefore need to solve two problems: to access complementary technological knowledge not available in the venture, and to identify potential new markets for the new product. The identification of new markets is also driven by the need to reduce the development risk associated with highly innovative products.

We therefore expect that ventures which have been founded with the strategic goal to develop a highly innovative product will, from early on, aim at a high breadth of linkages. Given that two types of linkages have been repeatedly cited in the literature for providing access to critical knowledge regarding the development of new products and their commercialisation (Meyskens & Carsrud, 2013; Rothaermel & Deeds, 2004), i.e. research linkages and market linkages, we assume this distinction to be relevant in particular for highly innovative new products. The significant challenge of ventures to develop a highly innovative new product thus lead us to posit that highly innovative ventures build up on both types of external linkages, i.e. research and market linkages:

Hypothesis 1: Ventures developing highly innovative new products are more likely to early-on focus on both, research linkages and market linkages.

Access to complementary marketing knowledge for technically focused ventures

External linkages providing complementary resources are important for ventures with a high degree of specialisation. As the founding team in nascent ventures is shaping the venture's core competences, technically focused founding teams are assumed to leave a technical "imprint" on their venture (Eesley, Hsu, & Roberts, 2014). Such a technically focussed venture has to solve the challenge that complementary resources are needed which help them to appropriate value from the innovation, but which are, at the same time, not available within the firm (Teece, 1986). Building up external market linkages is one solution to this challenge, as these allow technically focussed firms to detect new market trends and asymmetries faster than firms lacking such connections (Stam & Elfring, 2008).

Depending on the environment, different external actors provide market-relevant knowledge. While the role of incumbents in providing complementary resources like regulatory knowledge or access to markets (Eesley et al., 2014) is well researched (Powell et al., 1996; Tripsas, 1997), the entrepreneurship literature has only scarce knowledge about the antecedents of selling activities (Matthews, Chalmers, & Fraser, 2018). Recent works have shown that industry associations or service providers play an important role in ante ceding such "selling activities" by allowing knowledge exchange on particular markets and by providing contacts to prospective customers and suppliers (Dalziel, 2006; Stam, 2010; Stam & Elfring, 2008; Watkins, Papaioannou, Mugwagwa, & Kale, 2015). Besides facilitating the access and distribution of new products in particular markets, industry associations also may increase a new products' legitimacy (Meyskens & Carsrud, 2013). As there are only few and distinct industry associations which are in generally well known within the industry in which the ventures are operating, and as also liabilities of newness play less a role, industry associations have the additional advantage that they substantially reduce the search costs for ventures.

We therefore expect that ventures characterised by strong technical competences will search for market linkages to compensate for lacking internal marketing capabilities. Building up linkages to external partners providing knowledge which is relevant for market access for a venture's new prototype hence solves the problem that only certain assets have been developed internally (Ahuja,

2000). Altogether, we argue that a venture's skill composition shapes the search for complementary resources. A venture with a strong technical focus will be more likely to search for complementary linkages which provide market-related knowledge and information.

Hypothesis 2: Ventures with a technical focus are more likely to early on scale up internal product development by engaging in external market linkages.

3.3 Resource-constraint ventures and external linkage formation

If external linkages, and in particular diverse external linkages, are important in complementing a firm's resource-based, why do not all firms build up external linkages? Ahuja (2000) shows that an important antecedent of building up linkages are the existing resources at the firm-level. Hence, not only incentives to build up linkages matter like argued so far, but also the opportunities to create them. Depending on the resources available at the firm-level, opportunities for creating and entering external linkages differ substantially across firms (Ahuja, 2000; Hoang & Antoncic, 2003). Obviously, there is a trade-off between the search costs for complementary resources which are provided externally to the firm, and the resources available at the firm-level allowing for such a search. Important resource endowments that shape a venture's opportunities to establish external linkages are low levels of skill diversity and low levels of size. We focus on these resource endowments in the following.

Resource scarcity and ventures' skills uniformity

While some works have shown that the effect of diversity is not fully clear (Zhou & Rosini, 2015) as uniformity may have positive effects on common transactive memory systems (Chowdhury, 2005; Ensley, Carland, & Carland, 1998; Zheng, 2012), positive effects of diverse skill sets have been identified for research-driven firms like university-spin offs (Visintin & Pittino, 2014), for the implementation phase of innovations (Østergaard, Timmermans, & Kristinsson, 2011) and for the speed of innovation processes (Eesley et al., 2014). Also, functional diversity of management teams is linked to innovative performance (Protogerou, Caloghirou, & Vonortas, 2017). The skill diversity of the venture matters because it provides the knowledge base and the innovative capabilities of the

venture (Østergaard et al., 2011)[2]. Given the often small size of ventures, Østergaard et al (2011) have shown that employee diversity adds indeed diversity to the firm, but the overall direction does not change: a venture's skill diversity, often measured via the founding team's skill diversity, is beneficial for the venture's performance.

Diverse internal skills allow ventures to access a broader area of skills also external to the firm, and a broader variety of information and experience (Eesley et al., 2014, p. 1800). More diverse capabilities are further seen as being beneficial for a firm's absorptive capacity as they increase a firm's capability to exploit external resources (Cohen & Levinthal, 2000). This means that a venture's skill diversity also shapes the breadth of external linkages as more diverse knowledge bases allow for broader search activities (Nelson & Winter, 1982; Østergaard et al., 2011), and a broader pool of human capital to access linkages across all important phases of the innovation process (Østergaard et al., 2011).

However, restated, less diverse founding teams are constrained in their opportunities to search, and, compared to skill-diverse ventures, possess less opportunities to form external linkages (Ahuja, 2000). Combining the insight that founding team's skill diversity shapes the search for external linkages, and that scarce resources provide less opportunities to search, the interaction of the two is expected to reduce the breadth of external linkages. These arguments suggest the following hypothesis:

Hypothesis 3: Ventures with uniform skill sets are less likely to early on scale up internal product development by building up external research or market linkages.

Resource scarcity and venture size

Another important aspect of resource scarcity is a venture's size. As individual entrepreneurs cannot scale themselves up as firms can, "lone entrepreneurs" (Klotz, Hmieleski, Bradley, & Busenitz, 2014) face a finite search time (Dahlander et al., 2016). The search for external partners causes opportunity costs as external searching activities take the entrepreneur's attention away from other internal activities (Dahlander et al., 2016). When firms are small in size, and the human capital stock is low, it

[2] Starting with research on top management teams (Østergaard et al, 2011), research has focused on the role of the founding team being the first top management team of the venture.

is the entrepreneur herself who needs to carry out the search. Given that attention is a fixed resource and not infinitely elastic, small firms tend to search less for external partners. Indeed, a number of studies has shown a negative association between firm size and collaboration intensity (Chun & Mun, 2012), figuring between 10% to 60% (Czarnitzki, Ebersberger, & Fier, 2007; Howells, Ramlogan, & Cheng, 2012; Mangani & Gussoni, 2010). If small firms cooperate, then often only in later stages (Ruef, Aldrich, & Carter, 2003). As the small size does not allow entrepreneurs to scale up and to provide resources for search, it is therefore expected that firms with scarce resources in terms of firm size neither establish less external linkages, neither research nor market linkages.

Hypothesis 4 Highly constrained ventures in terms of size are less likely to early on scale up development by engaging in external research or market linkages.

4. METHODOLOGY

4.1 The Data: Sample and operationalization

To test the aforementioned hypotheses, we use a subset of the "Perfect Timing" (PT) database. Based on computer-assisted telephone interviews with founders, we collected this dataset in two waves between 2011 and 2018 with an international research team located in Utrecht (The Netherlands), New York (US), Germany (Düsseldorf and Cologne), London (UK), and Palermo (Italy). In order to capture possible variations in venture creation processes, the population interviewed includes ventures of all legal forms (excluding sole proprietorship) that were registered between 2004 and 2014 in the information technology (IT) and renewable energy (RE) industries in Germany, Italy, the US, the Netherlands and the UK. From this population, founders were randomly selected and invited to participate in an interview about the venture creation process of their company until a representative sample of 902 cases had been obtained. Out of these 902 cases we conducted all following steps in our analysis with the 402 ventures that indicated to have developed a new product as part of their venture creation process.

We collected the data with an explicit focus on the timing and sequencing of venture creation activities, which allows us to study patterns in linkage formation process in venture's new product development. Importantly, the dataset is restricted to the duration of the initial phase of the venture

creation process. This process begins with the first time a founder talked with someone else about setting up the venture in question, it ends at the moment when when the venture generated sustainable profits (defined as 3 consecutive profitable months). If a new venture never made sustainable profits, three alternative process ends can occur: namely the acquisition, merger or liquidation of the respective venture. If none of these events occurred until the date of the interview, the process of venture creation was categorized as ongoing and recorded up to a maximum duration of 84 months.

4.2 Dependent variable: The linkage formation process in new product development

For the purpose of this analysis we only consider the part of the venture creation process which is relevant for the development of a venture's main product. Accordingly, we consider the first time the venture starts developing its product as the starting point of the new product development; its end date corresponds to the end date of overall venture creation process as described above. For the purpose of the study consider the internal new product development to be completed when the first fully functional version of a product had been developed. With regard to the linkage formation activities undertaken during the venture creation process, we report which activities were undertaken to develop the product for each month.

In order to create a typology of linkage formation processes we determine the state of linkage formation for each month of venture creation. The state of linkage formation represents which constellation the venture developed its product in a particular month. We distinguish between internal new product development and new product development through external linkages. External new product development can either take the form research linkages or market oriented ones. Of course, a venture can simultaneously develop its product internally and with external linkages. Therefore we not only distinguish between the three basic ways of new product development but also account for each possible combination of them resulting in seven possible states that can occur in a venture's new product development process.

Table 1: Coding New Product Development Activities

Internal Development	External Linkages	Internal Development & External Linkages
Internal Development (ID)	Market Linkage (ML)	ID & ML
		ID & RL
	Research Linkage (RL)	ML & RL
		ID & ML & RL

The following Table 3 illustrates how we use this classification to arrive at state that depicts the linkage formation process as detailed as possible. In this hypothetic example the new product development in the venture takes place over period of 9 months. In the first two months the ventures focusses on the internal development of the product. Parallel to that it enters a research linkage with an external partner from months 3 through 5. In the following months the venture joins an association to ensure the market fit of its product through a market linkage. In month 8 it enters another research linkage to refine the product. The row "State" aggregates the linkage formation activities for every month as outlined above, thereby reporting the entire linkage formation process of our hypothetical venture.

Table 2: Example of a linkage formation process

Type	Month								
	1	2	3	4	5	6	7	8	9
Internal	ID	ID	ID	ID	ID	ID			
External			RL	RL	ML RL	ML	ML	ML RL	RL
State	**ID**	**ID**	**ID & RL**	**ID & RL**	**ID & RL &ML**	**ID & ML**	**ML**	**ML & RL**	**RL**

4.3 Independent Variables: Contextual factors

The innovativeness of a venture's business idea was determined in a three-step process. In the first step, the founder was asked what how novel product idea is.[3] In a second step, the interviewer (upon completion of the interview) cross-checked the founder's answer by comparing the venture's innovativeness with the innovativeness of the other ventures about which s/he had conducted interviews. In a third step, the person cleaning the data, again, cross-checked the degree of innovativeness indicated against the classification scheme he had developed while cleaning the entire dataset. In both step two and step three, the interviewer and the data cleaner relied on the information provided by the founder as well as on online information about the venture's business idea. This three-step process made it possible to minimize the over-estimation bias that typically occurs when founders self-report the level of their business' innovativeness. The novelty of the product idea was measured as imitation / improvement (0), or radical innovation (1).

Table 3: Dataset descriptives

Variable	Value	N	in %
Country	US	106	26.4%
	UK	59	14.7%
	Germany	154	38.3%
	Italy	46	11.4%
	Netherlands	37	9.2%
Novelty Product Idea	Not Radical	330	82.1%
	Radical	72	17.9%
Type of Good	Service	87	21.6%
	Mix	243	60.4%
	Product	72	17.9%
Number Employees	0	360	89.6%
	1	20	5.0%
	2	10	2.5%
	3	4	1.0%
	4	1	0.2%
	5+	7	1.7%

[3] Concrete question asked in the questionnaire: 'How would you describe the degree of novelty of your venture`s core business idea?'

Number of Founders	1	117	29.1%
	2	132	32.8%
	3	77	19.2%
	4	35	8.7%
	5+	41	10.2%
Industry	ICT	274	68.2%
	RE	128	31.8%
Tech Heavy	No	271	67.4%
	Yes	127	31.6%

In line with the literature we examine the effect of the composition of the founder team, both in diversity and specialization, on the approach to new product development a venture chooses. In our operationalization of these two measures we closely follow (Eesley et al., 2014). A founder (team) is characterized as technically focussed (1) if all founders indicated technical expertise as their main expertise. Teams with other expertise profiles are coded (0). The diversity of a founder team is measured by the number unique areas of expertise present in founder team divided by the number of founders.

Furthermore, we test for the effect of venture size, both in terms of number of employees a venture had hired by the time it started with its product development as well as the number of founders involved in setting up the venture. The 'Perfect Timing' dataset record only the first 5 founders and employees to be involved in the creation of the venture, hence does the category 5+ capture also ventures that potentially have more than 5 employee or founders respectively.

We control for venture characteristics that might influence the linkage formation process of a venture.Industries are structurally different and induce ventures to pursue different business models, requiring distinct organisational structures (Sine, Mitsuhashi, & Kirsch, 2006) and thus encourage different approaches to new product development. Therefore, a venture's industry was included as a control variable. It was determined in a three step process, where ventures were first sampled on the basis of NAICS industry codes and their business descriptions. In a second step, the person cleaning the samples drawn confirmed a venture's industry affiliation through online information, such as the venture's website. Finally, the founder was asked to confirm the venture's industry affiliation as part

of the interview. We group ventures into ICT (0) and Renewable Energy (1) ventures. Ventures that have an affiliation with both industries are classified as RE ventures. The second control variable included in our model is the type of good a venture produces. We assert whether a venture produces a tangible product (0), offers only services (2), or provides a mixture of both (1). This variable was recorded in the same three-step process as the ventures innovativeness.

4.4 Analyses

In line with our theoretical illustrations, we run two different types of analyses: **(1)** in a first step, we assess whether ventures follow systematically different approaches linkage formation process throughout the development of their product. If distinct linkage formation processes exist, we want to explore what they look like and differ on. To this end, we use optimal matching (OM) techniques combined with cluster analyses, whereby the linkage formation process itself constitutes the unit of analysis. The OM algorithm measures the distance between processes. If subsequently paired with cluster analyses, such sequence analyses allow us to explore and interpret patterns in longitudinal data (Halpin, 2010). We apply OM techniques because, when compared to other methods, OM has been found to deliver superior results in identifying patterns in sequence data in the context of management science (Biemann & Datta, 2014).

In the context of new venture creation, the first detailed OM application focuses on team formation process (Held, Herrmann, & van Mossel, 2018). In a more general study on venture creation processes Gordon (2012) used OM techniques to sequence gestation activities. Given that more wide-ranging developments and applications of OM algorithms only occurred after the year 2000, OM can still be considered a fairly young method. Nevertheless, a standard way of running sequence analyses, based on OM techniques, has crystallized, which we here follow (Biemann & Datta, 2014). It includes four steps:

Step 1: Coding the Data

The first step consists in reporting the linkage formation process of each venture on a monthly basis. More concretely, this means that a sequence of linkage formation states, depicting each venture's linkage formation process, needs to be created for each venture. The reported linkage formation

process can vary in length for each venture as the length is a result of time that passed between the first product development activity and the end of the venture creation process.

Step 2: Define the Substitution Costs

In order to measure the distance between two linkage formation sequences, created in Step 1, a cost needs to be assigned for replacing one state by any other state with the aim of transforming one sequence into the other. These so-called substitution costs range from 0 to an arbitrary maximum (here: 2) and are estimated on the basis of the relative frequency of transitions between two states within the entire dataset. Based on this transition frequency between any two funding states, a so-called substitution cost matrix is determined

The resulting substation cost matrix reveals that transitioning from a state featuring only one of the three basic linkage formation activities (Internal, Research Linkage and Market Linkage) is always cheapest to a state featuring the respective state in combination with another state. Not surprisingly, is transitioning to and from the state featuring all three activities cheapest vis-à-vis the three states combining two of the activities each.

Table 4: Substitution Cost Matrix

	ID	RL	ID & RL	ML	ID & ML	RL & ML	ID, RL &ML
ID	0						
RL	1.997598	0					
ID & RL	1.978305	1.965557	0				
ML	1.993012	1.996324	2.000000	0			
ID & ML	1.990971	2.000000	2.000000	1.957143	0		
RL & ML	2.000000	1.989339	2.000000	1.980757	2.000000	0	
ID, RL & ML	1.999782	2.000000	1.977779	2.000000	1.987806	1.943262	0

Step 3: Calculating Sequence Similarity

Based on these substitution costs, it is calculated (for each of the 402 sequences in our dataset) how costly it is to transform one sequence into any of the other 401 sequences. The cost of transforming one sequence into the other expresses their respective distance to one another. To determine the

distance of sequences that differ in length, we calculate their distance based on the length of the shorter of the two sequences. This reflects that the shorter of the two linkage formation processes is unknown beyond the period observed and should thus not influence the distance measure. This novel solution was introduced in Held et al. (2018) and addresses an often voiced concern of using OM for analysing sequences in social science that vary greatly in length (Aisenbrey & Fasang, 2010).

Furthermore, we normalize the respective values of sequence difference by dividing them by the length of the shorter of the two sequences in order to maintain a comparable difference measure across sequence pairs. This results in a matrix which reports the distances between each sequence pair.

Step 4: Perform a Cluster Analysis

In the concluding step, the funding acquisition processes are clustered on the basis of their respective distances to one another. Consequently, each cluster obtained encompasses those processes that are particularly similar to each other, and distant to the processes of other clusters. Accordingly, each cluster represents one of the most frequent and, thus, typical approaches to funding acquisition. We run the cluster analysis based on the Ward's minimum variance method, which has been shown to consistently produce the most accurate sequence clustering within the framework of OM analyses (Dlouhy & Biemann, 2015).

We use a combination of various partition quality measurements, namely the Weighted Average Silhouette Width (ASWw), R^2, Point Biserial Correlation (PBC), and Hubert's C (HC) to determine the optimal clustering solution amongst all solutions between one and twenty clusters. These measures indicate how similar sequences are within one cluster and how different they are between clusters. Consequently, we calculated these indicators for one, two, three, etc., up to twenty clusters in order to determine their goodness of fit. In this way, we could determine for which cluster number the goodness of fit is maximized. In doing so, we could exclude those cluster solutions which either did not yield distinct approaches, because they clustered together too different sequences, or which spread out sequences over too many similar clusters.

(2) In order to provide meaning and context to the results of an exploratory process analysis an explanatory analysis to understand *"what factors cause the different sequences observed"* is a logical

next step (Van de Ven & Engleman, 2004). Hence, in the second step, we use one-versus-rest logistic regression models to identify the conditions that influence approaches during the linkage formation process (dependent variable). In testing *Hypotheses 1-4* we research in how far innovativeness, the technological focus, diversity of the founder team as well as the number of employees and founders (independent variable) are correlated with the approach to linkage formation a venture chooses. We furthermore control for the venture's industry and whether the venture develops a service or rather a tangible good.

We fit the following model for each cluster to obtain the estimates:

$$ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 Innovativeness_i + \beta_2 TechFocus_i + \beta_2 FounderDiversity_i + \beta_3 Employees + \boldsymbol{\beta}' \boldsymbol{x}_i \quad (1)$$

where p_i denotes the probability that venture i belongs to the cluster rather than to any of the other clusters, β_0 the cluster's intercept, β_1, β_2, and β_3 the estimated coefficients for our independent variables, $\boldsymbol{\beta}$ a vector of coefficients for the control variables, and $\boldsymbol{x}_i$ a vector of control variables.

5. RESULTS

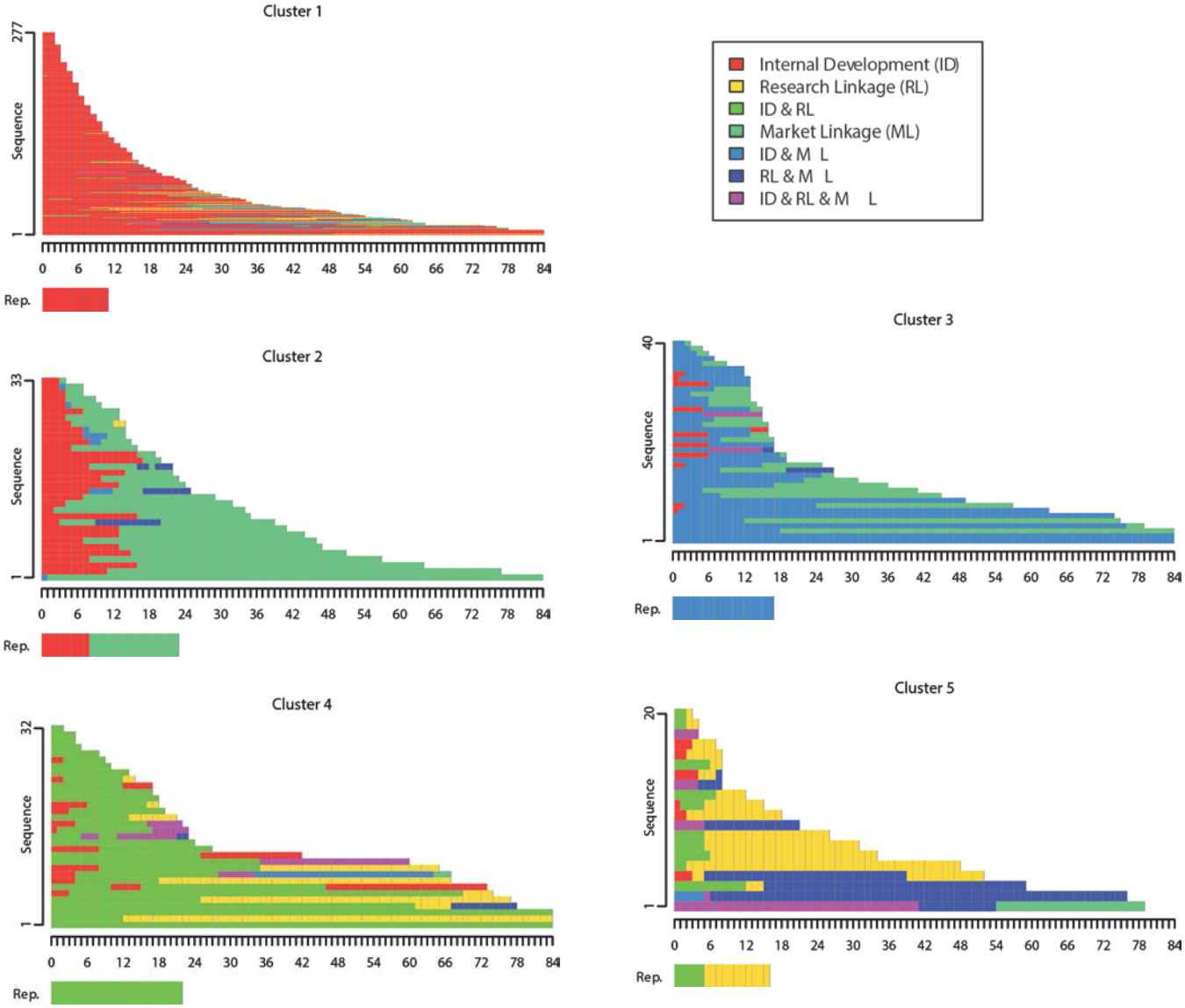
5.1 Patterns in Linkage Formation Processes

In the first part of our analysis we explore the variance in linkage formation processes in nascent ventures. More precisely, we analyse which distinct combinations and sequences of internal development, research and market linkages nascent ventures use to develop their products. The partition quality measurements point to the 5 cluster solution as the optimal solution for the linkage formation processes of nascent ventures. This solution combines the partition quality measurements better than any other considered solution (ASWw = 0.68; R^2 = 0.62; PBC = 0.78; HC = 0.07). As a result we observe 5 distinct linkage formation processes that nascent ventures engage in.

By far the most common amongst these processes is one dominated by internal product development (Cluster 1). 277 of the ventures in our sample go through this linkage formation process which is on average also a much shorter one than other linkage formation processes. The shorter processes in this cluster do not involve external linkages of either type. Only ventures in this cluster that do invest more than 12 months start creating external linkages.

Ventures in the smaller Cluster 2 (n = 33) also begin the process of developing their new product internally but start creating market linkages between months 6 and 12. Around the same time the ventures finish the internal development of the product. In other words: We observe a clear two step sequence of first developing the product and then ensuring its market fit. A different patterns emerges in Cluster 3 (n = 40). Here the ventures enter into market linkages in parallel to developing their new product internally. While the linkage formation activities are the same the clusters differ in sequence and timing of deploying them.

Graph 1: Patterns in Linkage Formation Processes



A similar phenomenon can be observed amongst ventures that pair internal development with research linkages (Cluster 4 & 5). Ventures in Cluster 4 (n = 32) run internal development in parallel to entering research linkages for the vast majority of their linkage formation process. Their counterparts in Cluster 5 (n = 20) in contrast discontinue their internal development after a brief development period at the beginning of the linkage formation process and continue the process exclusively through the means of research linkages or in some cases research and market linkages.

In general we can observe that in the sequence of linkage formation ventures have a clear preference to first develop products internally or form research linkage before they form market linkages. As shown above this can take place in distinctly different processes, but is overall in line with the expectations of the literature (Rothaermel & Deeds, 2004).

5.2 Determinants of approaches to the Link Formation Process

After exploring what different processes exist in the new product development of nascent ventures, we examine in the next steps what the drivers of the uncovered variety in these processes are. For this purpose we compare the characteristics of ventures in each cluster with those of the ventures in rest of the sample in binary logistic regressions to determine in how far cluster membership is correlated with particular venture characteristics.

In Hypothesis 1 (H1) we predicted, that ventures novel product ideas are more likely to early-on focus on both, research linkages and market linkages. We can confirm this hypothesis in so far as the one cluster in which ventures regularly form both research and market linkages (Cluster 5) is positively correlated with novel product ideas (C5; Exp $\beta = 3.339$; $p < .05$). The other cluster positively, but not significantly, correlated with novel product ideas heavily relies on the creation of research links (Cluster 4). Furthermore observe, that non-novel product ideas are correlated with market linkages. The two clusters that focus on market linkages either significantly negatively (C3; Exp $\beta = .158$; $p < .05$) or practically not correlated with novel products (Cluster 2). We thus find convincing evidence for Hypothesis 1.

Table 5: Binary Regression Analysis of Linkage Formation Clusters

	Linkage Formation Process Cluster (Exp β)				
Variable	Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5
Industry	.433***	1.136	2.297**	2.802	1.497
Type of Good - Mix	1.054	.282***	2.128	2.439	1.087
- Product	1.203	.189**	2.524	3.272*	.22
Degree Novelty	.898	1.01	.158**	1.892	3.339**
Number Employees	.695***	1.237	1.721***	.87	.977
Number Founders	.889	1.188	.97	1.164	1.145
Tech Heavy	.822	.944	2.115*	.764	1.205
Founder Team Diversity	.43**	2.492	.761	6.568**	1.93
Intercept	8.257***	.067***	.042***	.004***	.015***
Observations in Cluster	227	33	40	32	20
R^2	.082	.081	.144	.11	.076

p-values *** < .01, ** < .05,

Our second hypothesis (H2) focuses on the role that the technical orientation of a venture might play in creating market linkages throughout the linkage formation process. The literature led us to predict that ventures with a technical focus are more likely to early on scale up internal product development by engaging in external market linkages In the light of this hypothesis we would expect those clusters which are characterized by engaging in market linkages (Cluster 2, 3) to consist of technical heavy ventures. In line with this expectation we observe that ventures in Cluster 3 are more than two times as likely as other ventures to have a tech focussed founder team, albeit at a weak significance level (C3; Exp $\beta = 2.115$; $p < .1$). In contrast, ventures in Cluster 2 are less likely than the average venture in our sample to be led by a technical heavy founder team. While this finding is not significant, we can confirm Hypothesis 2 only partially. It is noteworthy however and in line with the hypothesis that the ventures that create market linkage from the get go are the ones significantly correlated with a strong technical focus.

With regard to the effect of expertise diversity within the founder team on the linkage formation process of nascent ventures we formulated in Hypothesis 3 (H3) that ventures with uniform skill sets are less likely to early on scale up internal product development by building up external research or market linkages. Our binary regression analyses indeed reveal that the founder teams of ventures which do not at all or only late in the linkage formation process form external linkages have a

significantly less diverse expertise set (C1; Exp $\beta = .043$; $p < .05$). In addition, the ventures in three out of the four clusters that are characterized by the formation of research or market linkages are positively correlated with more diverse expertise sets. The ventures in the one cluster (Cluster 3) not in this group might be able to compensate for a lack of diversity of expertise in their founder teams through an above average number of employees (C3; Exp $\beta = 1.721$; $p < .01$).

In our fourth hypothesis (H4) we postulate that highly constrained ventures in terms of size are less likely to early on scale up development by engaging in external research or market linkages. We find support for this hypothesis in form of those ventures being made of particularly small founder and employee teams (Cluster 1) being the same one not to form external linkages as a part of their linkage formation process.

Not surprisingly the control variables in the form of industry and type of good also influence the approach of a venture to new product development. First and foremost we observe, that the type of good of ventures develops has a clear impact on some of process clusters. Ventures in Cluster 1 first develop their new product exclusively internally before forming market linkages after 6-12 months. The products these ventures develop are very likely to be services rather than tangible products (C1; Exp $\beta = .189$; $p < .01$). Since Cluster 1 is the only one with a strong and clear focus on services, this insight indicates that developing a service depends much more on ensuring market fit through the creation of market linkages rather than research links. In addition, we find that the linkage formation process of ventures varies depending on the industry it is active in. Operating in the ICT industry is clearly associated with developing ones product internally rather than through external linkages (C1; Exp $\beta = .433$; $p < .01$). In contrast, ventures in the RE industry are more likely to form either a market or research linkage at some point in their linkage formation process (Cluster 2-5).

6. DISCUSSION AND CONCLUSIONS

This study makes an empirical contribution and provides a methodological innovation. Empirically, it contributes to the sparse knowledge regarding the relationship between the formation of external linkages of nascent ventures in knowledge intensive industries for new product development and the characteristics driving it. Methodologically, it introduces the optimal matching technique to research

on external linkage formation processes in new product development. We illustrate how external linkage formation differs, both across firms and across time, in terms of external partners chosen in this process. This allows us not only to better understand differences in linkage formation patterns of nascent ventures in new product development, but also to differentiate their linkage formation processes during time.

The results presented in this paper support our prediction that entrepreneurs in nascent ventures fulfil important coordinative roles by making use of external linkages to complement firm-level resources. We showed that ventures with highly innovative product ideas, from the beginning onwards and before the first prototype has been developed, build up external breadth by combining research and market linkages. We assume that the underlying mechanism is that the combination of these linkages, in our case external research projects and membership in industry associations, allows the access to more diverse sets of knowledge and information, and reduce the market risk of the new product (Ireland et al, 2002). We also showed that ventures with a heavy technical skill composition tend to complement their knowledge stock with linkages that provide market-related knowledge.

The dataset provides also new evidence regarding the tendency to collaborate in new product development: Most surprising, though not in the focus of this paper, is the simple evidence that the large majority in our sample can be characterized as nascent ventures without any external linkages, in particular in the early stage of product development. Given the rich literature on the value that external linkages create for new ventures (Hoang & Antoncic, 2003; Hoang & Rothaermel, 2010; Nieto & Santamaría, 2007; Rothaermel, 2001), this simple descriptive finding is interesting in itself. This finding suggests that we should gain a better understanding of the factors hindering entrepreneurs to search for external linkages. This paper should be also understood as a first attempt to do so. We showed how resource constraints work as a barrier for building up external linkages, and demonstrated that constraints in terms of the ventures' skill set and of the firm size have a negative impact on the probability to engage in external linkages. Hence, though external linkages substantially increase a firm's competitiveness (Hoang & Rothaermel, 2010; Nieto & Santamaría, 2007; Rothaermel, 2001), resource constraints of nascent ventures are significant barriers to create these linkages.

Furthermore, our perspective on research and market linkages is relevant as it demonstrates the importance of different stages in new product development. Building up on the exploration–exploitation learning framework of March (1991) and Rothaermel et al (2004), we showed that ventures take different decisions regarding their choice of linkages: We find clusters of ventures which decide for research linkages, others for market linkages, and a further cluster of ventures choosing both. We explain these strategic choices with different degrees of product idea novelty and the ventures' skill composition. Nascent ventures with highly novel product ideas obviously strategically combine external knowledge and capabilities contained in research and market linkages. This is a very interesting observation, given that the literature has stressed that, vice versa, the outcome of broad linkages tends to be novel. While we cannot, given our data structure, statistically show that the causality is indeed reverse to what has been stated in the literature (Hoang & Rothaermel, 2010; Nieto & Santamaría, 2007; Rothaermel, 2001), anecdotal evidence from our interviews strongly supports our argument: Our interviewees who answered to have intended to develop a highly novel product reported, when asked about the path leading to it, that they, from the very early product idea onwards, tried to build up broad external linkages to improve access to technical knowledge stocks not available in their ventures, and, at the same time, to early on access market-relevant information to gain more fine-grained information on potential changes of the prototype, distribution channels, and marketing partners.

This paper has two implications. First, our findings indicate that that there are distinct types of temporal patterns of external linkage formation processes in new product development. Based on the exploration–exploitation framework, we have been able to identify a distinct number of approaches to engage in external linkages, varying between research linkages, market linkages or a combination of both. We also found that in many cases, ventures refrain from entering external partnerships in an early stage.

Second, our regression analyses suggest that the different approaches towards the formation of linkages are driven by the ventures' resource endowment. We identified a number of factors that

induced different approaches, namely the products' idea novelty and the venture's breadth of skills. We also identified factors that are associated with a preference of internal development, namely the scarcity of firm-level resources both in terms of size and skills. This latter observation makes an important addition to the long-held belief that the entrepreneurs' search for complementary resources is driven by incentives to complement existing resources. While this is true, obviously, it is important to take the scarcity of resources of nascent ventures into account. The opportunity costs of resource-underequipped ventures seem to be often higher than from what could gained from external linkages. This finding supports earlier work of Ahuja (2000) which is, to the best of our knowledge, the only work that has taken the role of opportunity costs in building up linkages into account.

In interpreting the results of this study, certain limitations must be kept in mind. First and most important, our data do not allow us to identify prior linkage formation experiences of the venture's founder. A number of studies has shown that prior networking experience matters (Mora-Valentin, Montoro-Sanchez, & Guerras-Martin, 2004; Okamuro, Kato, & Honjo, 2011; Paier & Scherngell, 2010) so that our study may overestimate the role of product idea novelty and breadth of skills. Further, the identification of clusters implies that we subdivide our dataset and run regression analyses on comparatively small groups of ventures. In this light an even larger n would be desirable. Nevertheless, we are confident that our results contribute significantly to the understanding of external linkage formation processes of nascent ventures.

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Submission to SBEJ

Held, L. (Lukas)
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Dear Erik,

please find attached our paper *'Whom do I search for? Variances of Linkage Formation Processes of Nascent Ventures in New Product Development'* to consider for publication in *Small Business Economics*. We believe the paper is well suited to the scope of your journal, because it contributes to the understanding of linkage formation in new product development in entrepreneurship by analyzing the linkage formation process of nascent ventures.

We look forward to the results of the review process, and would be delighted to see the paper eventually published in your journal.

Thank you for considering our manuscript for publication and kind regards,

Lukas Held, Andrea Herrmann and Cornelia Storz

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